UNITED NATIONS UNIVERSITY
UNU-WIDER

WIDER Working Paper 2022/129

The effects of taxation on income inequality in sub-Saharan Africa

Idrissa Ouedraogo,[1] Issa Dianda,[2] Pegdwende Patrik Ouedraogo,[3] Rodrigue Tiraogo Ouedraogo,[4] and Bassirou Konfe[5]

November 2022

United Nations University World Institute for Development Economics Research
wider.unu.edu

Abstract: This paper investigates the effects of taxation on income inequality in an unbalanced panel of 45 countries in sub-Saharan Africa over the period 1980–2018. We use instrumental-variable two-stage least squares and instrumental-variable quantile regression estimates. We find that taxation widens income inequality. We also show that the increasing effects of taxation on income inequality are higher in the most unequal countries than in the least unequal countries. Furthermore, we highlight an inverse U-shaped relationship between indirect taxes and income inequality. Governments in sub-Saharan Africa should increase indirect taxes to at least 28.36 per cent of gross domestic product in order to reap the dividends in terms of reducing inequality.

Key words: income inequality, taxation, quantile regression, sub-Saharan Africa

JEL classification: C26, D31, D63, H23

Acknowledgements: The authors are grateful to Abel Gwaindepi, Abrams Tagem, Evgeniya Dubinina, Herman Ndoya, Ibrahim Dia, Rasmane Guigma, Rita Nikiema, Steve Hall, colleagues at the Department of Economics of the Thomas Sankara University, and participants at a UNU-WIDER Workshop 'Data for Tax Revenue Mobilization' in April 2022 for their insightful comments. The usual disclaimer applies.

[1] Department of Economics, CEDRES (Centre d'Études, de Documentation et de Recherches Économiques et Sociales), Thomas Sankara University, Saaba, Burkina Faso; corresponding author: pridrissoued87@yahoo.fr; [2] Department of Economics, CEDRES, and Nazi Boni University, Bobo Dioulasso, Burkina Faso; [3] Department of Economics, CEDRES

This study has been prepared within the UNU-WIDER project GRD – Government Revenue Dataset. It is part of UNU-WIDER's Domestic Revenue Mobilization (DRM) programme, which is financed through specific contributions by the Norwegian Agency for Development Cooperation (Norad).

Information and requests: publications@wider.unu.edu

ISSN 1798-7237 ISBN 978-92-9267-262-1

https://doi.org/10.35188/UNU-WIDER/2022/262-1

Typescript prepared by Luke Finley.

United Nations University World Institute for Development Economics Research provides economic analysis and policy advice with the aim of promoting sustainable and equitable development. The Institute began operations in 1985 in Helsinki, Finland, as the first research and training centre of the United Nations University. Today it is a unique blend of think tank, research institute, and UN agency—providing a range of services from policy advice to governments as well as freely available original research.

The Institute is funded through income from an endowment fund with additional contributions to its work programme from Finland, Sweden, and the United Kingdom as well as earmarked contributions for specific projects from a variety of donors.

Katajanokanlaituri 6 B, 00160 Helsinki, Finland

1 Introduction

Income inequality has been a long-standing issue for economic development, and its widening remains a political, economic, and social challenge for policy-makers (Blanchard and Rodrik 2021; Holcombe and Boudreaux 2016; Karakotsios et al. 2016). Inequality is a key source of low productivity, economic inefficiency, lessened aggregate demand, shorter growth cycles, low growth, political and economic instability, and conflict that reduces investment and deprives the poor of the ability to stay healthy and accumulate human capital (Doyle and Stiglitz 2014; Ostry et al. 2014; Stiglitz 2012). Higher inequality leads to less investment in infrastructure, technology, and education (Doyle and Stiglitz 2014). It also increases the likelihood of an economy succumbing to a severe recession (Berg and Ostry 2017) and of poverty (Fosu 2018). In addition, addressing income inequality is an important issue in the current development agenda globally. For example, Sustainable Development Goal (SDG) 10 aims at reducing inequality within and among countries. African Union Agenda 2063 also aims at reducing income inequality between individuals in African economies.

Despite the economic growth recorded in recent decades, sub-Saharan Africa (SSA) remains one of the regions with the highest levels of inequality in the world (Odusola 2017; Xu et al. 2021). According to the International Monetary Fund (IMF 2015) and the UN Department of Economic and Social Affairs (UNDESA 2019), SSA is the second-most unequal region in the world after Latin America and the Caribbean (LAC). It is also home to 10 of the 19 most unequal countries in the world[1] and 7 economies considered outliers of inequality (Cornia et al. 2017). Furthermore, the richest 10 per cent alone held about 55 per cent of national income in SSA in 2016 (Alvaredo et al. 2018). In 2020, the global top 10 per cent income share was 56 per cent and the share of the top 1 per cent was 22 per cent, against only 9 per cent for the bottom 50 per cent (Chancel and Piketty, 2021). The global top 1 per cent and 10 per cent share was respectively 22 and 32 times higher than that of the bottom 50 per cent in the same year (Chancel and Piketty 2021).

As addressing income inequality is an important issue in policy efforts to lower poverty and increase welfare, understanding why it is high in SSA is crucial (Fosu 2018). One factor that has recently attracted the attention of economists and other social scientists is taxation (Duncan and Sabirianova Peter 2016).[2] Taxation is viewed by some economists as a powerful solution to promote a more equal income distribution (Atkinson 2015; Musgrave 1959; Piketty 2014). Since the 1980s, countries in SSA have experienced notable tax policy reforms aimed at increasing domestic resource mobilization.

Despite this renewed focus on the redistributive effects of taxation and the persistence of income inequality in SSA, empirical investigations have generally dwelt on developed countries (Atkinson and Leigh 2010; Brinca et al. 2021; Ciminelli et al. 2018; Muinelo-Gallo and Roca-Sagalés 2013). Empirical studies based on developing countries have focused on LAC (Martorano 2018) and Asia

[1] South Africa, Namibia, Botswana, Central African Republic, Comoros, Zambia, Lesotho, Eswatini, Guinea-Bissau, and Rwanda.

[2] Other drivers of income inequality have attracted the attention of social scientists. These include growth (Risso et al. 2013), human capital (Li and Yu 2014), globalization (Heimberger 2020), international trade (Huang et al. 2022), foreign direct investment (Pan-Long 1995), natural resource exploitation (Kim et al. 2020), political regime (Bahamonde and Trasberg 2021), urbanization (Sulemana et al. 2019), inflation (Al-Marhubi 1997), financial development/liberalization (Koudalo and Wub 2022), employment/unemployment (Björklund 1991), economic freedom (Compton et al. 2014), and remittances (Bang et al. 2016).

(Cevik and Correa-Caro 2019), while other studies have used mixed panels (Claus et al. 2013; Duncan and Sabirianova Peter 2016; Martínez-Vázquez et al. 2012). These studies do not provide insights into the formation and dynamics of income inequality in SSA.

In terms of empirical strategy, previous research on the link between taxation and income inequality has been based on ordinary least squares (OLS: Alavuotunki et al. 2019; Odusola 2017; Song 2013) and instrumental variable (IV) methods such as generalized methods of moments (GMM: Cornia et al. 2011; Martorano 2018) and two-stage least squares (2SLS; Odusola 2017). These approaches have disadvantages, as they only estimate the parameters of interest at the mean evaluation by a conditional distribution of the dependent variable (Billger and Goel 2009). However, it is necessary to examine the effects of taxation at different intervals throughout the income inequality distribution, given the possibility that inequality feeds on itself. If this is the case, income inequality would tend to become more entrenched in already unequal nations. Finally, the effects of taxation are not necessarily uniform. For example, the impact of direct taxes on inequality may differ from that of indirect taxes: direct taxes are generally considered progressive, whereas indirect taxes are considered regressive (Martínez-Vázquez et al. 2012). Therefore, the differentiated effects of taxation on income inequality should also be accounted for.

This paper investigates the distributional effects of taxation in an unbalanced panel of 45 countries in SSA over the period 1980–2018. The paper makes four contributions to the growing empirical literature on the relationship between taxation and income inequality. First, it focuses on the SSA region, given its high income inequality traits (Odusola 2017; Xu et al. 2021) and its challenges in raising tax revenue. While most of the existing research and policy discussions have focused on developed countries and developing countries in other regions, less attention has been paid to the SSA region.[3] This paper contributes to filling this gap by analysing the relationship between taxation and inequality in SSA.

Second, it analyses the effects of different taxes on income inequality. This allows us to identify the types of taxes that increase (or decrease) income inequality. The disentanglement of the specific contribution of different types of taxes provides more evidence on the relationship between taxation and income inequality. The understanding of the distributional effects of different taxes can be helpful in moving towards tax systems with more equity, without sacrificing efficiency (Nantob 2016).

Third, the paper investigates the effect of taxation on different parts of the income distribution. For example, the effects of taxes may be different at different quantiles of the distribution of income inequality. In addition, the effects on income inequality may be different in countries with different levels of income inequality (low, moderate, or high).

The fourth contribution relates to the evidence of a threshold effect in the relationship between indirect taxes and income inequality in SSA.

The rest of the paper is organized as follows. Section 2 presents a brief literature review on the effects of taxation on income inequality. Section 3 describes the data and presents the methodology. Section 4 presents the estimated effects of taxation on income inequality in SSA. Section 5 concludes and discusses some policy implications.

[3] Inequality in the region has received limited attention historically from a research, policy, and political perspective (Cornia et al. 2017).

2 Literature review

2.1 Theoretical literature

Theoretically, it is recognized that taxation is one of the tools used by government to address income inequality (Clements et al. 2015; Freitas 2012). Taxation can be seen from two angles: the amount of tax revenue collected and the tax structure. Both of these matter for income inequality reduction (Odusola 2017). The literature suggests that there are two channels through which taxation can affect the distribution of income. The tax system attenuates income inequality directly by increasing its progressiveness, and indirectly by increasing additional revenue to finance expenditure on reducing income inequality.

On the one hand, the direct channel indicates that a country's ability to reduce income inequality depends on its tax structure (Hubmer et al. 2016; Mirrlees 1971; Piketty 2001; Ramsey 1927). The interest in the redistributive role of the tax structure can be traced back to the work of Meltzer and Richard (1981). They argue that when average income rises relative to median income in the income distribution, most low-income earners are more inclined to demand higher taxes in the form of progressive taxation. Progressive taxes redistribute resources from the most fortunate to the poorest (Odusola 2017). The reliance of tax system on either direct or indirect taxes determines its progressivity and therefore its capacity to reduce income inequality. Generally, direct taxes are progressive, meaning that tax rates rise along with income. Conversely indirect taxes are regressive (Martínez-Vázquez et al. 2011). Direct taxes are paid by the taxpayer to the entity that levies them; they include personal income tax, corporate income tax, taxes on payroll and workforce, and taxes on property. Indirect taxes, levied on the seller but paid by the buyer, comprise taxes on goods and services and international trade and transactions. Given that direct taxes reduce the concentration of wealth at the top end of the distribution, a tax system based on progressive tax (income taxes, individual and corporate taxes) is equalizing (Benhabib et al. 2011; Freitas 2012; Hubmer et al. 2016; Mirrlees 1971; Odusola 2017; Piketty 2001; Ragot 2017). Controversially, a tax structure reliant on taxes on goods and services (sales taxes, value-added taxes, excises taxes, customs duties) and international trade and transactions is assumed to be regressive and expected to have a negative impact on income distribution (Martínez-Vázquez et al. 2011).

On the other hand, the indirect channel reveals that the use of taxes matters in relation to reducing income inequality (Muinelo-Gallo and Roca-Sagalés 2011). A high fiscal capacity gives governments more fiscal space in which to undertake expenditure on public goods such as education and health in favour of the poorest segments of society (Clements et al. 2015). This expenditure may foster the income of marginalized people. Likewise, spending on social security shifts income towards the middle and bottom part of the distribution, thus reducing income inequality (Salotti and Trecroci 2018). In the same vein, Bird (2003) argues that the main role of fiscal policy is to foster economic growth and then reduce income inequality.

2.2 Empirical literature

A review of the empirical literature on the effects of taxes on income inequality reveals two main trends. While some authors analyse the effect of taxation level on income inequality, others investigate the effect of tax structure.

In the first strand of literature, Piketty (2001) indicates that the progressive taxes introduced at the beginning of the twentieth century in France have led to a significant reduction in income

inequality over a long period.[4] Hayes and Medina Vidal (2015) investigate the effect of tax policies on the level of income inequality using panel data on 50 US states over the period 1976–2006. Using dynamic fixed effects and error correction methods, they find that distributive expenditures, such as unemployment benefits, lead to a reduction in inequality. In the same vein, Ragot (2017) attributes the growth of income inequalities in the USA over the last 30 years to a reduction in the progressivity of taxation on capital.

Ramos and Roca-Sagalés (2008) use a vector autoregressive (VAR) model with data covering the period 1970–2007 to estimate the long-run effects of tax variables on the evolution of Gini coefficients of income inequality in the UK. They show that there are significant distributional effects associated with taxation. By conducting a descriptive and documentary analysis on 22 developed and 128 developing countries with data covering the period 1990–2005, the IMF (2015) shows that taxation reduces income inequality. Martorano (2018) analyses the redistributive role of taxes in 18 Latin American countries over the period 1990–2015. Using the dummy variable least squares estimator, difference GMM, and system GMM, he shows that overall, when governments conduct taxation policy through income tax, it plays an important role in income redistribution in these countries.

In contrast, other authors find that taxation exacerbates income inequality. Song (2013) examines the effects of China's tax system on regional income inequality using data for 28 provinces over the period 1978–2007 and OLS. He finds that China's expenditure-based tax distribution has contributed to increasing income inequality over the past three decades. Unlike the work above which found a significant effect of taxation on inequality, Domeij and Heathcote (2004) find that taxation does not affect it. In a case study on Guatemala, they assess the impact of taxes on income inequality using survey data covering the period 2009–2010. They find that taxation does not contribute to reducing income inequality in the country.

In the second strand, authors have analysed the compositional effects of taxes on income inequality. To this end, Ciminelli et al. (2018) analyse the effects of tax composition on income inequality in 16 Organization for Economic Co-operation and Development (OECD) countries using panel data covering the period 1978–2012. Using a VAR model, their results show that indirect taxes reduce income inequality more than direct taxes do. Goñi et al. (2011), through a comparative analysis, show that in Europe, direct taxes reduce the Gini coefficient of income by an average of 15 per cent compared with 2 per cent reduction in Latin America. Conducting a descriptive analysis, Jellema and Tassot (2018) find that in Togo, direct taxes and non-monetary transfers are the tax instruments that have the greatest influence on reducing income inequality. Adam et al. (2015) investigate the effect of capital taxation and tax on workers' income on income inequality in 75 developing and developed countries for the year 2010. They find that whereas tax on capital increases income inequality, tax on workers' income reduces it. Cabrera et al. (2015) find that in the Guatemalan case over the period 2009–2011, although direct taxes are progressive, their redistributive effect is negligible due to their weakness. Indirect taxes, especially those on consumption, are rather regressive. In total, the regressivity of indirect taxes outweighs the progressivity of direct taxes, so that tax policy as such does not affect income inequality.

In sum, the existing literature shows no consensus view on the effects of taxation on income inequality. Our paper adds new insights to the growing literature on the effects of taxation on income inequality, focusing on SSA. In addition, little attention has been paid to the threshold effect of taxation on income distribution. Moreover, since different taxes can have differentiated

[4] Work carried out in the US supports this result.

effects on income inequality, we investigate the effects of different taxes on income inequality. Since taxation may have different effects on different parts of the distribution of income, we also investigate the effect of taxation on different parts of the distribution of income. Our baseline empirical models are estimated using OLS and IV-2SLS, and instrumental-variable quantile regression (IVQR) is applied to analyse the effect of taxation on different parts of the distribution of income.

3 Data and methodology

3.1 Data

We use annual data based on an unbalanced panel of 45 SSA countries[5] over the period 1980–2018. The choice of sample size and study period is dictated by data availability.

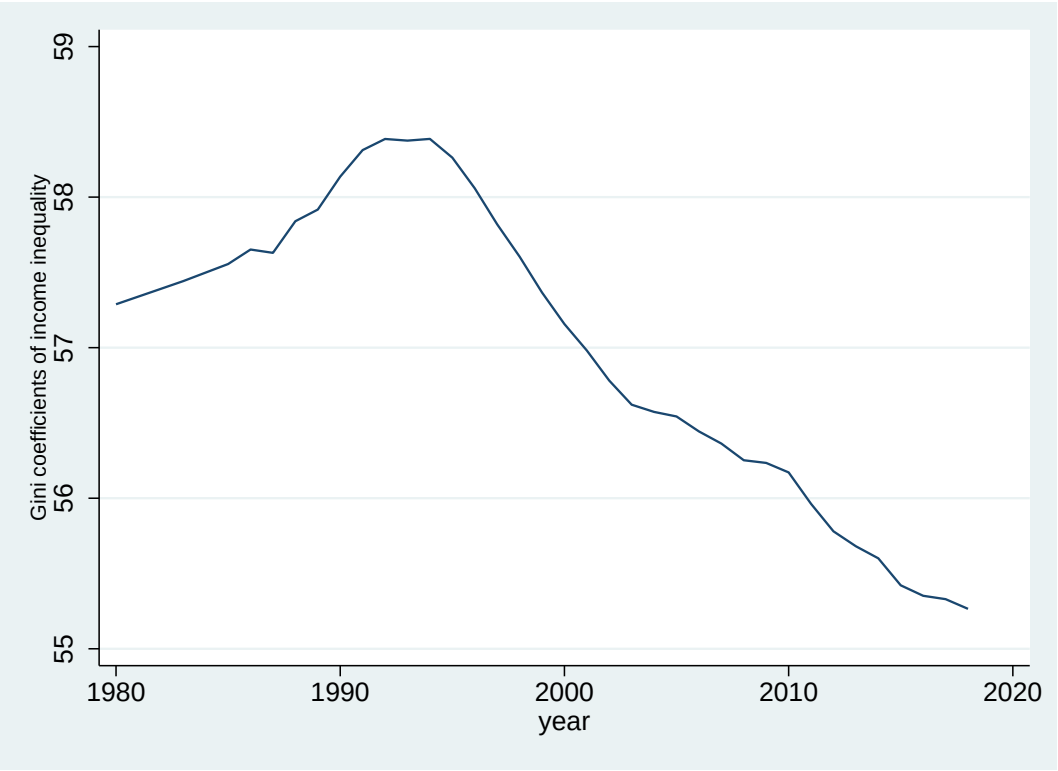
We use data for Gini coefficients of income inequality from the World Income Inequality Database (WIID) version 2021 (UNU-WIDER 2021b). This is because Gini coefficients of income inequality are more readily available on an internationally comparable basis (Christopoulos and McAdam 2017). They also allow a relatively easier comparison of income inequalities between countries (Bergh and Nilsson 2010) and across time. Gini coefficients are theoretically bounded between 0 (meaning that each reference unit receives an equal share of income) and 100 (meaning that a single reference unit receives all income while all the others receive nothing).[6]

Figure 1 presents the income inequality trends in SSA over the period 1980–2018. The evolution of the Gini coefficient suggests two major trends. On one hand, between 1980 and 1995, an upward trend in the Gini coefficient is observed, reflecting an exacerbation of income inequality. On the other hand, over the period 1996–2018, the Gini index has been declining. This decline reflects a reduction in income inequality over this period. This downward trend also been highlighted by Cornia et al. (2017), which indicates that between 1991 and 2011, the Gini coefficient decreased by 3.4 percentage points. Although income inequality has been declining, on average, its level is still high in SSA, with a mean value estimated at 57 (see Appendix, Table A1). This high level of income inequality can be explained in part by the inability of governments to ensure an equitable redistribution of the wealth of the region through taxation policies. Over the period 1980–2018, the Gini coefficients of income inequality varied from 41.80 (Djibouti) to 72.47 (Burkina Faso), which means that Burkina Faso has the greatest income inequality of the countries in our sample.

[5] The list of countries in the sample are Angola, Benin, Botswana, Burkina Faso, Burundi, Cabo Verde, Cameroon, Central African Republic (CAR), Chad, Comoros, Democratic Republic of Congo (DRC), Congo, Côte d'Ivoire, Djibouti, Equatorial Guinea, Eritrea, Eswatini, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Namibia, Niger, Nigeria, Uganda, Rwanda, Senegal, Sierra Leone, South Africa, Sudan, Tanzania, Togo, Zambia, and Zimbabwe.

[6] See UNU-WIDER (2021b) for details on the content and the methodology.

Figure 1: Income inequality trends in sub-Saharan Africa, 1980–2018



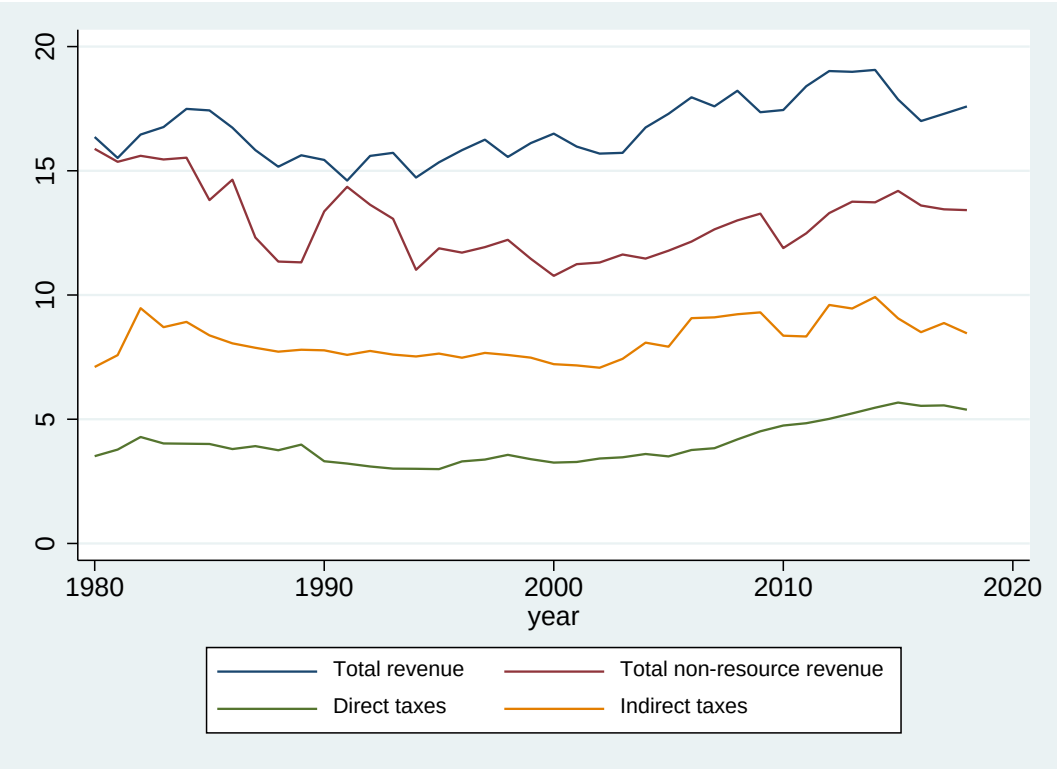
Source: authors' construction using data from UNU-WIDER (2021b).

For robustness checks, we use an alternative indicator of income inequality: the Palma ratio. The Palma ratio is the share of the top 10 per cent of income divided by the share of the bottom 40 per cent. This measure of income inequality has become popular as more income inequality research focuses on the growing divide between the richest and poorest in society. The trends portrayed by the income inequality measured by the Gini coefficients are confirmed with the Palma ratio (Appendix, Figure A1). Over the period 1980–2018, the Palma ratio varied from 2.06 (Djibouti) to 15.88 (Burkina Faso), confirming the finding obtained with the Gini index that Burkina Faso has the greatest income inequality in our sample.

Data on taxes are taken from the Government Revenue Dataset (GRD), version 2021. GRD provides the most complete, high-quality, and transparent cross-country dataset on public revenues available in developing countries (UNU-WIDER 2021a). It is updated annually, collating data from major international databases, and draws on data compiled from the public archive of IMF Article IV Staff Reports. Data on taxes cover total revenue, total non-resource revenue, direct taxes, and indirect taxes. All variables on taxes are in percentage of GDP.

Figure 2 presents tax trends in SSA over the period 1980–2018. From 1980 to 1990, total revenue, total non-resource-revenue, direct taxes, and indirect taxes slightly decreased. However, from the early 1990s there have been reforms to tax policy which have also slightly increased these taxes.

Figure 2: Tax trends in SSA, 1980–2018

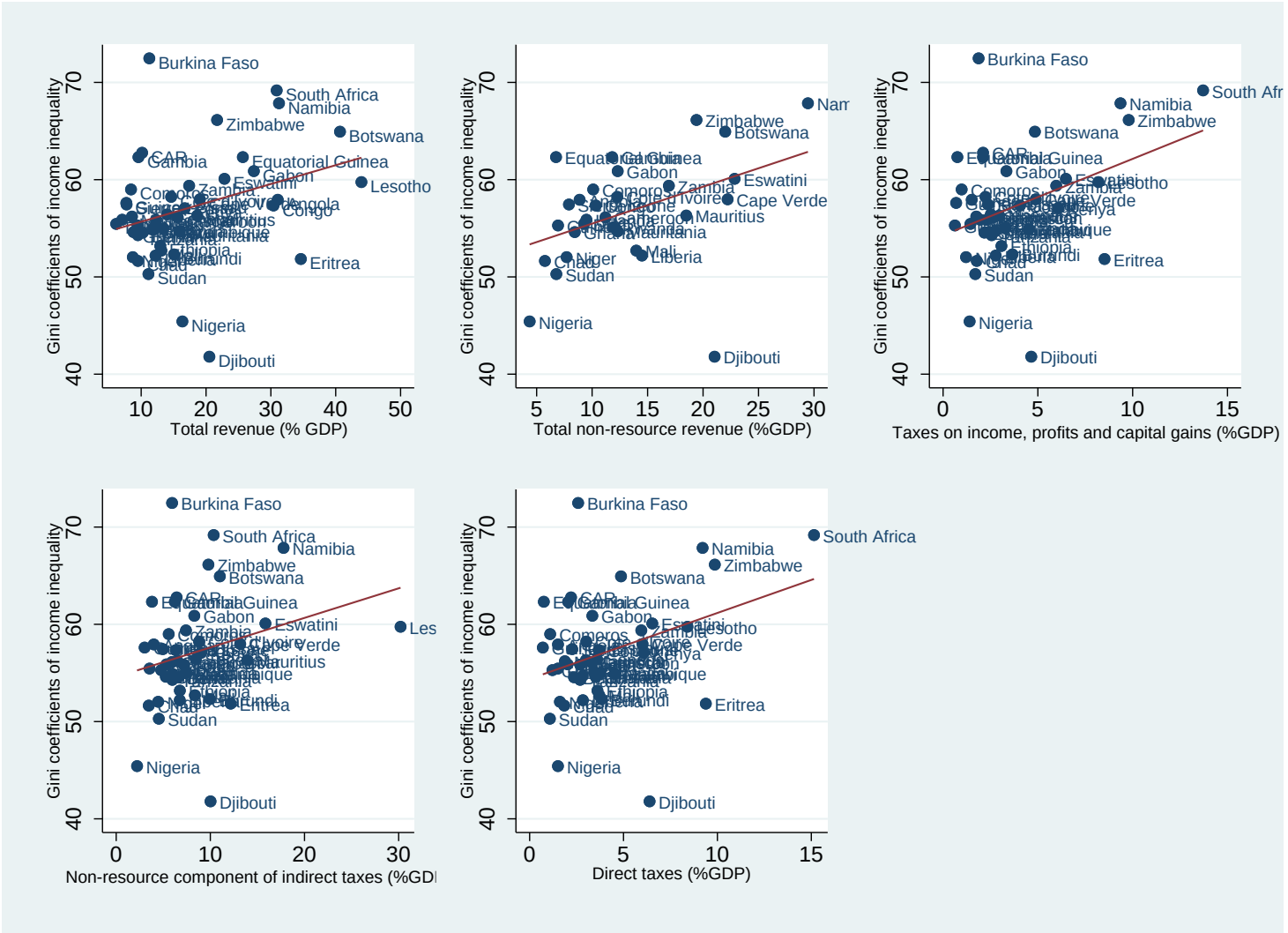


Source: authors' construction based on data from UNU-WIDER (2021a).

Over the period 1980–2018, total revenue, total non-resource tax revenue, direct taxes, and indirect taxes respectively represent 16.68 per cent, 12.73 per cent, 3.95 per cent, and 8.16 per cent of GDP (Appendix, Table A1). In addition, these taxes are strongly correlated with one another (Appendix, Table A2). In the econometric analysis, using these variables simultaneously in the same regression can generate multicollinearity problems. Therefore, tax variables are introduced individually into the regressions in the next sections (3.2 and 4).

Figure 3 presents the correlation between taxes and income inequality in SSA over the period 1980–2018. Overall, the correlation analysis shows that taxes are positively correlated with income inequality: tax policy is potentially not redistributive. Countries in SSA which have higher taxation tend to have high income inequality.

Figure 3: Correlation between taxes and income inequality in SSA,1980–2018



Source: authors' construction based on data from UNU-WIDER (2021a, b).

We include many variables to control for potentially important determinants of income inequality. These variables include primary net enrolment rates,[7] nets flow of foreign direct investment in percentage of GDP, trade openness, total natural resources rent in percentage of GDP, urbanization rate, inflation rate, domestic credit to private sector in percentage of GDP, employment rates, public expenditure on education in percentage of GDP, remittances, real GDP per capita, and real GDP per capita squared. These variables are taken from the World Development Indicators database (World Bank 2022). We also control for political system using the polity2 variable from the Centre for Systemic Peace (CSP 2022) as a proxy for democracy. Following Rodrik (2000), democracy is a meta-institution, an institution from which other institutions in a country are born or strengthened.[8] Appendix Table A2 shows that the multicollinearity problem is not a concern, because overall correlation between independent variables is relatively low.

3.2 Methodology

To investigate the distributional effects of taxation in SSA, we use OLS, IV-2SLS, and IVQR.

We start with a simple model, or a naive approach, that does not consider the possible endogeneity between some variables in the econometric model: the OLS. Next, we use IV-2SLS to address the issue of the identification strategy, to deal with the endogeneity problem related to taxes, democracy (polity2), and education. Taxation is endogenous, due to reverse causality from income inequality to taxes and vice versa (Adam et al. 2015). In countries with higher income inequality, policy-makers may choose to rely more on direct or indirect taxation (Martínez-Vázquez et al. 2012).

Endogeneity can also stem from measurement errors in relation to the democracy variable and reverse causality between education and inequality. The variable for democracy is derived from expert opinions and survey data and is therefore potentially subject to measurement errors: this variable is not observed but, instead, is estimated. Regarding the endogeneity of education, 'any observed relationship between education outcomes and income inequality may reflect reverse causation, i.e. current income inequality also affects current educational attainment and its dispersion. Therefore, any unobserved factors that affect income inequality and also education outcomes can bias the estimated relationship between education outcomes and income inequality' (Coady and Dizioli 2017: 2750). Children of affluent parents get more and better schooling than children of poor parents, which seems to imply that reducing income inequality would reduce inequality in schooling (Mayer 2010).

Two types of instruments are generally used in the empirical literature: internal and external instruments. Internal instruments are the endogenous variables taxation, democracy, and education lagged at order 1 and order 2. We choose those lags to limit issues of degrees of freedom. The external instrument is the legal origin of a country (La Porta 1999; La Porta et al. 2008). This is a dummy variable that takes the value 1 if the legal origin of a country is French and 0 otherwise.

OLS and IV-2SLS estimate the parameters of the econometric model only at the mean of the conditional distribution of the dependent variable. They do not allow us to analyse the distributional effects of taxation across the conditional distribution of income (for example at the

[7] This variable is used to approximate human capital. It better reflects the quality of human capital relative to the gross rate. Also, data are more readily available for this variable compared with the secondary and tertiary enrolment rates.

[8] In the choice of variables, we prioritize variables which have more observations over others, while taking into account their relevance in the literature.

10th, 25th, 50th, 75th, and 90th quantiles of the distribution of income inequality). However, tax effects on income inequality could be different in countries with different levels of income inequality (low, moderate, or high).

We employ IVQR to account for these limitations. IVQR not only accounts for the endogeneity issues highlighted above, but also estimates the effects of taxation across different parts of the distribution of income. The quantile regression is robust to distributional assumptions and produces non-sensitive estimates—properties that are absent in the linear-regression model (Hao and Naiman 2007). It is robust to outliers and does not require independence or a weak degree of dependence (Kudryavtsev 2009). IVQR is also used in previous studies on the determinants of wage inequality (Bargain and Kwenda 2014; Chletsos and Roupakias 2020; Martinsa and Pereira 2004), across the mortality distribution (Yang et al. 2012) and income inequality (Altunbaş and Thornton 2018; Demir et al. 2020). IVQR was introduced by Chernozhukov and Hansen (2005). It implements the smoothed estimator of Kaplan and Sun (2017), who show that smoothing improves both computation time and statistical accuracy. The quantile estimator is obtained by solving the following optimization problem for the θth quantile, $(0 <\theta<1)$:

$$\min_{\beta \in R^k} \left[\sum_{i \in \{i: y_i \geq x_i' \beta\}} \theta |y_i - x_i' \beta| + \sum_{i \in \{i: y_i < x_i' \beta\}} (1-\theta) |y - x_i' \beta| \right] \quad (1)$$

In Equation 1 yi is the dependent variable, and xi a vector k by 1 of explanatory variables. Quantile regressions minimize the weighted sum of the absolute deviations, obtaining for example the 10th or 90th quantiles by weighting the residuals appropriately. The conditional quantile of yi given xi is given by Equation 2:

$$Q_y(\theta | x_i) = x_i' \beta_0 \quad (2)$$

IVQR is used for the baseline results. However, for comparison and robustness check purposes, OLS and IV-2SLS are also used.[9] In IVQR, the 50th quantile is the median effects, while estimates from OLS and IV-2SLS are the mean.

Equation 3 presents the econometric model that is used for regressions:

$$INEQ_{it} = \beta_0 + \beta_1 T_{it} + \beta_2 EDUC_{it} + \beta_3 VAC_{it} + \beta_4 FDI_{it} + \beta_5 OPEN_{it} + \beta_6 NRR_{it} + \beta_7 URB_{it} + \beta_8 INF_{it} + \beta_9 FD_{it} + \beta_{10} ER_{it} + \beta_{11} GEE_{it} + \beta_{12} ln\,(REM)_{it} + \beta_{13} ln\,(GDPpc)_{it} + \beta_{14} ln(RGDPpc)_{it}^2 + \mu_{it} \quad (3)$$

with i a country; t the year; μit the error term; and $\beta 0, \beta 1, \ldots, \beta 14$ the parameters of the model. $INEQ$ is the income inequality measure. T is a tax measure. Taxes variables include total revenue, total non-resource revenue, direct taxes, and indirect taxes. $EDUC$ is the primary net enrolment rate, a proxy for human capital in SSA. FDI is the net flow of foreign direct investment (percentage of GDP). $OPEN$ is trade openness (percentage of GDP). NRR is total natural resources rents (percentage of GDP). URB is the urbanization rate. $DEMOC$ (polity2) is a proxy of democracy. INF is the inflation rate, a measure of macroeconomic stability. FD is financial development, measured by domestic credit to the private sector (percentage of GDP). ER is the employment rate. GEE is the total public expenditure on education (percentage of GDP). REM stands for remittances. $RGDPpc$ is real GDP per capita, a proxy of economic development. Real GDP per

[9] For additional robustness checks, OLS with time fixed effects, cluster for years and cluster for countries, quantile regression, and instrumental variables with internal instruments are used.

capita squared is introduced to account for Kuznets (1955) effects, allowing us to check where there is an inverted U-shaped relationship between income inequality and economic development in SSA.

4 Results and discussion on the effects of taxation on income inequality in SSA

4.1 Effects of taxation on income inequality

The estimated effects of taxes on income inequality using OLS, IV-2SLS, and IVQR are presented in Tables 1–4. The results of the diagnostic tests show that all the models are well specified. The key statistics of interest are the Hansen J statistics test for over-identification, which has p-values higher than 0.10, and the Kleibergen-Paap rk Wald F statistic of weak exogeneity, which is well above 10. These statistics indicate that the instruments are valid and relevant, providing confidence that they are sufficiently strong.

Table 1 presents the distributional effect of government total revenue in SSA. This table shows that government total revenue increases income inequality in SSA. Its increasing effects are greater in countries with higher income inequality: it is greater in the most unequal countries (the 75th and 90th quantiles) than in the least unequal countries (the 10th and 25th quantiles). This effect is lower at the median distribution of income compared with those of the two previous groups. At the mean distribution of income inequality (IV-2SLS), total government revenue has an increasing effect, although this effect is lower than that of the median one (IVQR 0.50). This result can be explained by the structure of the tax system in SSA, due to the preponderance of indirect taxes, which affect poor and rich alike. In fact, given that the average propensity to consume is generally higher among the poor than the rich, a tax system in which indirect taxation is preponderant exacerbates income inequality. In this research, indirect taxes are estimated at 8.16 per cent of GDP compared with 3.95 per cent of GDP for direct taxes. Thus, indirect taxes are more than twice as high as direct taxes. Our results do not accord with those of Jellema and Tassot (2018) and Cabrera et al. (2015), who find respectively that taxation reduces income inequality in Togo and does not affect income distribution in Guatemala.

Table 1: Total revenue and income inequality in SSA, 1980–2018

	Dependent variable: Gini coefficient of income						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Independent variables	OLS	IV-2SLS	IVQR 0.10	IVQR 0.25	IVQR 0.50	IVQR 0.75	IVQR 0.90
Total revenue	0.192***	0.183***	0.195***	0.226***	0.188***	0.236***	0.313***
	(0.0242)	(0.0335)	(0.0367)	(0.0225)	(0.0341)	(0.0497)	(0.0627)
Democracy (polity2)	−0.245***	−0.346***	−0.197***	−0.163***	−0.179***	−0.212**	−0.249*
	(0.0534)	(0.0709)	(0.0701)	(0.0424)	(0.0677)	(0.0956)	(0.140)
Trade openness	−0.0772***	−0.0752***	−0.0818***	−0.0791***	−0.0704***	−0.0643***	−0.0767***
	(0.00594)	(0.00686)	(0.00521)	(0.00651)	(0.0189)	(0.0165)	(0.00826)
Foreign direct investment	0.00357	0.00660	0.120***	0.109***	0.0263	0.00161	−0.128**
	(0.0368)	(0.0434)	(0.0331)	(0.0274)	(0.0441)	(0.0499)	(0.0572)
Total natural resources rents	0.00810	0.00864	−0.0366	−0.0304	−0.0132	0.0236	0.167**

	(0.0243)	(0.0327)	(0.0261)	(0.0244)	(0.0330)	(0.0675)	(0.0807)
Urbanization rate	0.00663	0.00526	0.0269	0.0411**	0.0447*	0.0205	−0.105**
	(0.0186)	(0.0215)	(0.0210)	(0.0197)	(0.0247)	(0.0394)	(0.0414)
Inflation rate	0.107**	0.112**	0.140***	0.111***	0.0955***	0.0466	0.0301
	(0.0460)	(0.0535)	(0.0296)	(0.0296)	(0.0300)	(0.0404)	(0.0646)
Financial development	0.0474***	0.0628***	0.0205	0.0275**	0.0295*	0.0425	0.0960***
	(0.0156)	(0.0216)	(0.0163)	(0.0136)	(0.0175)	(0.0325)	(0.0254)
Public expenditure on education	0.707***	0.913***	0.678***	0.575***	0.779***	0.516**	0.531
	(0.143)	(0.174)	(0.167)	(0.137)	(0.145)	(0.209)	(0.382)
Primary education	−0.00205	−0.0196	0.0551*	0.0116	0.0184	−0.0339	−0.145***
	(0.0241)	(0.0289)	(0.0308)	(0.0159)	(0.0206)	(0.0266)	(0.0358)
Employment rate	−0.0561*	−0.0411	−0.0640**	−0.0332**	−0.0412	−0.0532	0.00930
	(0.0293)	(0.0373)	(0.0295)	(0.0163)	(0.0300)	(0.0476)	(0.0530)
Ln(GDP per capita)	−7.122	−5.221	1.319	5.012	−10.22	−6.467	−3.907
	(6.691)	(6.858)	(4.433)	(3.999)	(6.373)	(7.864)	(13.03)
Ln(GDP per capita squared)	0.511	0.394	−0.00873	−0.245	0.709	0.461	0.307
	(0.465)	(0.477)	(0.314)	(0.299)	(0.477)	(0.528)	(0.989)
Ln(Remittances)	−0.276	−0.265	−0.366***	−0.314***	−0.214	−0.200	−0.167
	(0.225)	(0.251)	(0.125)	(0.103)	(0.146)	(0.273)	(0.301)
Constant	82.70***	74.70***	39.66**	29.53**	89.62***	83.20***	83.84**
	(23.62)	(24.04)	(15.65)	(14.58)	(24.76)	(29.84)	(40.07)
Observations	322	272	272	272	272	272	272
Prob > F	0.0000						
Kleibergen-Paap rk LM statistic p-value		0.0000					
Cragg-Donald Wald F statistic		274.383					
Hansen test P-value		0.761					

Note: robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' construction based on CSP (2022), UNU-WIDER (2021a, b), and World Bank (2022).

Table 2 presents the effects of total non-resource tax revenue on income inequality in SSA over the period 1980–2018. The results show that the non-resource component of total income does not affect income inequality in SSA countries with low-income inequality (the 10th and 25th quantiles). In contrast, in countries with high income inequality (in the 75th and 90th quantiles), this component increases income inequality. It also increases income inequality at the median (the 50th quantile). This median effect is greater than the mean effect, which is also positive and statistically significant. These significant positive results (50th, 75th, and 90th quantiles) are broadly consistent with those obtained with total revenue. Total non-resource revenue constitutes a significant share of total revenue. Non-resource taxes represent 12.73 per cent of GDP compared with 16.68 per cent for total revenue (Appendix, Table A1). In countries with an ineffective tax system, taxation tends to increase income inequality, especially when inequality is higher in these countries. Non-resource tax revenue can increase income inequality by pushing up the income share of high-income earners.

Table 2: Total non-resource revenue and income inequality in SSA, 1980–2018

	Dependent variable: Gini coefficient of income						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Independent variables	OLS	IV-2SLS	IVQR 0.10	IVQR 0.25	IVQR 0.50	IVQR 0.75	IVQR 0.90
Total non-resource revenue	0.162**	0.184*	−0.0324	0.0776	0.213**	0.338**	0.363***
	(0.0665)	(0.0986)	(0.201)	(0.134)	(0.0843)	(0.136)	(0.138)
Democracy (polity2)	0.0249	0.0482	−0.0167	−0.0735	0.00393	0.00814	0.0740
	(0.0480)	(0.0602)	(0.0725)	(0.0746)	(0.0781)	(0.0894)	(0.0687)
Trade openness	−0.0574***	−0.0453***	−0.0317	−0.0488***	−0.0629***	−0.0627***	−0.0544***
	(0.00984)	(0.0126)	(0.0203)	(0.0178)	(0.00834)	(0.0127)	(0.00723)
Foreign direct investment	−0.0148	−0.0249	−0.00759	−0.0258	−0.126**	−0.185***	−0.171**
	(0.0582)	(0.0787)	(0.0576)	(0.0527)	(0.0501)	(0.0711)	(0.0698)
Total natural resources rents	0.0983***	0.123***	0.000574	0.0414	0.0834***	0.0989***	0.105***
	(0.0204)	(0.0326)	(0.0640)	(0.0521)	(0.0308)	(0.0284)	(0.0228)
Urbanization rate	−0.0776**	−0.111***	−0.0777**	−0.0117	−0.0364	−0.127***	−0.168***
	(0.0321)	(0.0371)	(0.0348)	(0.0400)	(0.0357)	(0.0458)	(0.0450)
Inflation rate	0.0710***	0.0702**	0.148***	0.110***	0.0629*	0.0357	0.0343
	(0.0256)	(0.0281)	(0.0317)	(0.0356)	(0.0346)	(0.0284)	(0.0209)
Financial development	−0.148***	−0.169***	−0.297***	−0.170**	−0.107***	−0.0915***	−0.0973***
	(0.0342)	(0.0454)	(0.0959)	(0.0719)	(0.0374)	(0.0263)	(0.0212)
Public expenditure on education	0.621***	0.519***	0.483***	0.579***	0.541***	0.721***	0.770***
	(0.149)	(0.193)	(0.139)	(0.171)	(0.156)	(0.235)	(0.178)
Primary education	0.0278	0.0217	0.112***	0.0318	0.0105	−0.00610	1.90e-05
	(0.0183)	(0.0199)	(0.0397)	(0.0305)	(0.0219)	(0.0166)	(0.0133)
Employment rate	0.0794**	0.137**	0.170**	0.134*	0.0637	0.0292	0.0629
	(0.0383)	(0.0545)	(0.0701)	(0.0807)	(0.0567)	(0.0632)	(0.0465)
Ln(GDP per capita)	−4.762	−1.811	−28.04*	−20.97*	−7.839	10.11	20.36*
	(7.782)	(8.926)	(15.83)	(11.41)	(7.438)	(11.73)	(11.11)
Ln(GDP per capita squared)	0.749	0.628	2.486**	1.872**	0.877	−0.367	−1.049
	(0.553)	(0.649)	(1.241)	(0.861)	(0.583)	(0.833)	(0.780)
Ln(Remittances)	−0.493***	−0.441**	−0.576**	−0.405	−0.152	−0.240	−0.461**
	(0.176)	(0.205)	(0.247)	(0.275)	(0.200)	(0.198)	(0.201)
Constant	47.36*	29.76	113.5*	98.91**	63.50**	5.701	-33.75
	(26.95)	(30.11)	(60.34)	(42.43)	(31.04)	(42.14)	(39.61)
Observations	133	115	115	115	115	115	115
Prob > F	0.0000						
Kleibergen-Paap rk LM statistic p-value		0.0001					

Cragg-Donald Wald F statistic	51.780
Hansen test P-value	0.4867

Note: robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' construction based on CSP (2022), UNU-WIDER (2021a, b), and World Bank (2022).

Tables 3 presents the effects of direct taxes on income inequality in SSA. The results show that direct taxes increase income inequality, and their increasing effects are greater in countries with higher income inequality. As with total revenue (Table 1), the increasing effects of direct taxes on income inequality are greater in the most unequal countries than in the least unequal countries. In addition, the effect at the median distribution of income is positive and higher than that at the mean in the regression with total direct taxes but the opposite in the other regression. This result implies that in SSA, direct taxes does not necessarily favour progressivity in the tax system. This is contrary to the theoretical prediction that direct taxes are progressive and that they reduce income inequality. They do not reduce the concentration of wealth in the top end of the distribution and are not equalizing. Rather, they widen income inequality in the region.

Table 3: Direct taxes and income inequality in SSA, 1980–2018

	Dependent variable: Gini coefficient of income						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Independent variables	OLS	IV-2SLS	IVQR 0.10	IVQR 0.25	IVQR 0.50	IVQR 0.75	IVQR 0.90
Direct taxes	0.578***	0.596***	0.418*	0.537***	0.736***	0.905***	0.917***
	(0.124)	(0.143)	(0.223)	(0.182)	(0.186)	(0.158)	(0.180)
Democracy (polity2)	−0.201***	−0.248***	−0.124*	−0.0925	−0.154	−0.220*	−0.104
	(0.0533)	(0.0705)	(0.0719)	(0.0576)	(0.103)	(0.114)	(0.0811)
Trade openness	−0.0751***	−0.0752***	−0.0894***	−0.0765***	−0.0707***	−0.0813***	−0.0835***
	(0.00717)	(0.00724)	(0.0104)	(0.00894)	(0.0174)	(0.0103)	(0.00636)
Foreign direct investment	0.00719	0.00410	0.153***	0.0971**	−0.0287	−0.0499	−0.168***
	(0.0368)	(0.0423)	(0.0554)	(0.0416)	(0.0352)	(0.0585)	(0.0450)
Total natural resources rents	0.0396	0.0102	0.00767	−0.0167	0.0188	0.0753	0.158***
	(0.0309)	(0.0384)	(0.0393)	(0.0359)	(0.0353)	(0.0625)	(0.0544)
Urbanization rate	−0.00599	−0.0161	0.0410**	0.0191	0.0177	−0.0774	−0.111***
	(0.0201)	(0.0232)	(0.0195)	(0.0215)	(0.0286)	(0.0597)	(0.0370)
Inflation rate	0.0539	0.0475	0.0756	0.0461	0.0281	0.0168	0.0270
	(0.0484)	(0.0561)	(0.0750)	(0.0483)	(0.0457)	(0.0540)	(0.0587)
Financial development	−0.0191	−0.00476	−0.0124	0.00185	−0.0420	−0.0346	−0.0206
	(0.0251)	(0.0295)	(0.0355)	(0.0272)	(0.0297)	(0.0228)	(0.0393)
Public expenditure on education	0.719***	0.807***	0.498***	0.342	0.631***	0.564***	0.633**
	(0.168)	(0.204)	(0.168)	(0.239)	(0.244)	(0.213)	(0.311)
Primary education	−0.0298	−0.0426	0.0263	−0.00739	−0.0144	−0.101*	−0.171***
	(0.0296)	(0.0334)	(0.0483)	(0.0192)	(0.0200)	(0.0560)	(0.0345)

Employment rate	−0.0264	−0.00629	−0.0416	0.000782	−0.00743	0.0213	0.0305
	(0.0347)	(0.0421)	(0.0445)	(0.0242)	(0.0213)	(0.0424)	(0.0466)
Ln(GDP per capita)	−28.38***	−27.31***	−3.443	−1.468	−34.91***	−42.83***	−39.37***
	(10.04)	(10.18)	(14.37)	(12.56)	(6.472)	(11.91)	(9.598)
Ln(GDP per capita squared)	2.105***	2.042***	0.445	0.296	2.568***	3.197***	2.914***
	(0.712)	(0.721)	(1.011)	(0.882)	(0.489)	(0.846)	(0.735)
Ln(Remittances)	0.0547	0.162	−0.276	−0.0399	0.152	0.448	0.200
	(0.305)	(0.336)	(0.279)	(0.219)	(0.289)	(0.288)	(0.327)
Constant	155.1***	150.6***	56.20	51.03	174.5***	209.8***	207.3***
	(34.99)	(35.12)	(45.12)	(42.62)	(22.07)	(44.17)	(31.34)
Observations	271	233	233	233	233	233	233
Prob > F	0.0000						
Kleibergen-Paap rk LM statistic p-value		0.0000					
Cragg-Donald Wald F statistic		269.305					
Hansen test P-value		0.4125					

Note: robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' construction based on CSP (2022), UNU-WIDER (2021a, b), and World Bank (2022).

The positive effect of direct taxes on income inequality in SSA can be explained by the narrowness of the tax base and the small size of these taxes. In addition, the appropriateness of direct taxes depends on the ability of the government to target pro-poor spending. This result contrasts with those established by Cornia et al. (2011) and Goñi et al. (2011) that direct taxes reduce income inequality respectively in the Latin American and European contexts.

Table 4 presents the results of the effect of indirect taxes on income inequality. From this table, it emerges that while indirect taxes increase income inequality in the least unequal countries (10th and 25th quantiles), they have no significant effect in the most unequal countries (75th and 90th quantiles). The amplifying effect of indirect taxes at the median distribution is smaller than at the mean distribution. In general, our results are in line with previous studies that find that indirect taxes increase income inequality (Bachas et al. 2020; Ciminelli et al. 2019; Ramos and Roca-Sagalés 2008). However, they disagree with the result established by Cornia et al. (2011) that indirect taxes reduce income inequality in the Latin American context.

Table 4: Indirect taxes and income inequality in SSA, 1980–2018

	Dependent variable: Gini coefficient of income						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Independent variables	OLS	IV-2SLS	IVQR 0.10	IVQR 0.25	IVQR 0.50	IVQR 0.75	IVQR 0.90
Indirect taxes	0.196***	0.153**	0.237**	0.209***	0.109**	0.0789	0.0902
	(0.0487)	(0.0641)	(0.102)	(0.0615)	(0.0463)	(0.0756)	(0.101)
Democracy (polity2)	−0.213***	−0.147*	−0.0156	−0.0598	−0.0414	−0.000521	−0.105
	(0.0703)	(0.0841)	(0.0744)	(0.0474)	(0.0662)	(0.103)	(0.110)
Trade openness	−0.0891***	−0.0925***	−0.0893***	−0.0881***	−0.0932***	−0.102***	−0.0978***

	(0.00759)	(0.00777)	(0.0176)	(0.0101)	(0.0103)	(0.00961)	(0.00808)
Foreign direct investment	0.0933***	0.115***	0.140***	0.139***	0.119**	0.143***	0.0883**
	(0.0339)	(0.0382)	(0.0418)	(0.0424)	(0.0466)	(0.0332)	(0.0415)
Total natural resources rents	−0.00260	−0.0528	−0.0633	−0.0938**	−0.0861**	−0.0516	0.0181
	(0.0321)	(0.0413)	(0.0443)	(0.0434)	(0.0406)	(0.0337)	(0.0654)
Urbanization rate	0.0316	0.00660	−0.000479	0.0184	0.0114	−0.0468	−0.0591
	(0.0231)	(0.0285)	(0.0315)	(0.0231)	(0.0286)	(0.0397)	(0.0661)
Inflation rate	0.121**	0.138**	0.104**	0.0876***	0.0903***	0.0965***	0.0663
	(0.0505)	(0.0540)	(0.0431)	(0.0287)	(0.0269)	(0.0276)	(0.0497)
Financial development	0.0230	0.0258	0.0283	0.0380	0.0184	0.00165	0.0225
	(0.0166)	(0.0178)	(0.0206)	(0.0240)	(0.0250)	(0.0248)	(0.0213)
Public expenditure on education	0.860***	0.887***	0.605**	0.685***	0.899***	0.913***	1.014***
	(0.130)	(0.136)	(0.243)	(0.187)	(0.149)	(0.137)	(0.169)
Primary education	−0.0196	−0.0233	0.0294	0.00156	−0.0162	−0.0107	−0.0749
	(0.0294)	(0.0306)	(0.0346)	(0.0154)	(0.0198)	(0.0201)	(0.0823)
Employment rate	−0.0719	−0.0983***	−0.0784***	−0.0979***	−0.122***	−0.212***	−0.154***
	(0.0440)	(0.0484)	(0.0299)	(0.0347)	(0.0360)	(0.0725)	(0.0584)
Ln(GDP per capita)	−17.00*	−17.31	10.10	5.216	−19.23**	−14.90*	−22.36
	(10.08)	(10.50)	(10.05)	(10.68)	(9.632)	(8.921)	(16.79)
Ln(GDP per capita squared)	1.282*	1.294*	−0.582	−0.298	1.388**	1.107	1.653
	(0.715)	(0.744)	(0.675)	(0.744)	(0.626)	(0.682)	(1.257)
Ln(Remittances)	−0.00378	0.111	−0.151	−0.129	0.272	−0.0467	0.0211
	(0.332)	(0.371)	(0.203)	(0.257)	(0.208)	(0.389)	(0.431)
Constant	116.5***	121.3***	14.63	38.72	131.5***	124.9***	155.1**
	(34.37)	(35.52)	(30.45)	(36.96)	(35.32)	(27.20)	(62.22)
Observations	230	210	210	210	210	210	210
Prob > F	0.0000						
Kleibergen-Paap rk LM statistic p-value		0.0000					
Cragg-Donald Wald F statistic		113.493					
Hansen test P-value		0.1155					

Note: robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' construction based on CSP (2022), UNU-WIDER (2021a, b), and World Bank (2022).

To sum up, we find that total revenue and its direct and indirect components widen income inequality over the period 1980–2018 in SSA. Globally, the increasing effects of taxation are higher in the most unequal countries of the region compared with the least unequal countries. These

results are robust to the different estimates (OLS, IV-2SLS, IVQR).[10] Furthermore, they are robust to the use of the Palma ratio as an alternative measure of income inequality (Appendix, Tables A3–A6).

In addition to taxation in the econometric model (Equation 3), we include a set of control variables which may affect the evolution of income inequality in SSA. Cross-tabulating the effects of the control variables in Tables 1–4 shows that globally, three of these variables are statistically significant. These are trade openness, democracy, and public expenditure on education (Appendix, Table A7).

The results indicate that trade openness reduces income inequality in SSA. Countries in SSA are small and import-dependent. Greater trade openness of a country therefore leads to increased imports, which contributes to lower prices at the national level, leading to gains for the consumer. This result is in accordance with the Stolper-Samuelson theorem (Stolper and Samuelson 1941) which predicts that trade openness decreases inequality in developing countries.

Public expenditure on education increases income inequality in SSA. In reality, in SSA countries, weak institutions mean that a large share of public spending on education is not actually spent on education. This raises the issue of the use of public resources to reach the poorest in the region, where governance is poor. In such an environment, increased public spending on education hardly means improved quality of or access to education for the poorest.

Democracy favours income distribution in SSA. According to Bahamond and Trasberg (2021: 2), democratic institutions are:

> a major source of responsiveness and accountability in the political economy literature, providing electoral incentives to redistribute income. Leaders in democratic countries need widespread support to achieve and sustain power and are, therefore, more likely to move beyond their narrow set of personal interests by appealing to a wider public through public policies (Meltzer and Richard 1981) … widespread enfranchisement in democracies is likely to result in higher public goods provision, which may help the poor to benefit from economic growth via investments in human capital … These policies are expected to produce more equal income distribution over time.

4.2 The effects of taxation on income inequality in sub-Saharan Africa: threshold effects

We detect a potential non-linear relationship between indirect taxes and income inequality in SSA (Appendix, Figure A2).[11] In the other taxes, we did not detect any non-linear relationship with income inequality. To test non-linearity, we include the squared indirect taxes in percentage of GDP as an explanatory variable, as shown in equation 6:

$$INEQ_{it} = \alpha_0 + \alpha_1 NTCIT_{it} + \alpha_2 (NTCIT)^2_{it} + \varepsilon_{it} \quad (6)$$

with $NTCITit$ indirect taxes in percentage of GDP for country i at year t. The marginal effects of indirect taxes on income inequality are computed as show in Equation 7:

[10] OLS with time fixed effects, cluster for years and cluster for countries, quantile regression, and instrumental variables with internal instruments produce qualitatively similar results.

[11] When we use qfit or lowess in the scatter plots.

$$\frac{\partial INEQ_{it}}{\partial NTCIT_{it}} = \alpha_1 + 2\alpha_2 NTCIT_{it} \quad (7)$$

The results of the estimation are portrayed in Table 5. We find that the quadratic term is significantly negative at the 1 per cent level while the non-quadratic term is significantly positive at the same level. The result provides evidence of an inverse U-shaped relationship between indirect taxes and income inequality in SSA over the period 1980–2018. This result suggests that although higher levels of indirect taxes are positively associated with income inequality, the effect is not constant. Income inequality increases as the share of indirect taxes in GDP increases, but it starts decreasing after it reaches a certain level. This level is 28.36 per cent in the OLS regression and 27.84 per cent in IV-2SLS regression.[12] It is far from the mean of indirect taxes in the region over the period 1980–2018, which is 8.16 per cent (Appendix, Table A1).[13] This relationship suggests that the marginal effect of indirect taxes exhibits decreasing effects on income inequality. The result implies that indirect taxes can contribute to reducing inequality when they amount to at least 28.36 per cent of GDP. Policy-makers should therefore work to increase this component, in order to make taxation policy redistributive. In our sample, only Lesotho has a level of indirect taxes higher than 28.36 per cent of GDP (30.20 per cent). In eight countries in the sample indirect taxes are between 10.01 per cent and 17.77 per cent of GDP, whereas they are lower than 10 per cent in 36 countries. These statistics reveal the extent of the effort required to make tax policy an instrument for reducing income inequality in SSA.

Table 5: Threshold effects of indirect taxes on income inequality,1980–2018

	Gini coefficient		Palma ratio	
	(1)	(2)	(3)	(4)
	OLS	IV-2SLS	OLS	IV-2SLS
Indirect taxes	0.553***	0.586***	0.238***	0.233***
	(0.0871)	(0.112)	(0.0376)	(0.0564)
(Indirect taxes)^2	−0.00975***	−0.0105***	−0.00473***	−0.00453***
	(0.00212)	(0.00318)	(0.000909)	(0.00160)
Constant	53.58***	53.32***	4.278***	4.261***
	(0.531)	(0.662)	(0.224)	(0.333)
Observations	1,225	1,122	1,225	1,122
Prob > F	0.0000		0.0000	
Kleibergen-Paap rk LM statistic p-value		0.0000		0.0000
Cragg-Donald Wald F statistic		13.91		13.91
Hansen test P-value		0.6312		0.1126

Note: robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' construction based on CSP (2022), UNU-WIDER (2021a, b), and World Bank (2022).

[12] With the Palma ratio, this level is 25.18 per cent for OLS and 25.72 per cent for IV-2SLS.

[13] In 2018, the most recent year in our data, the mean of indirect taxes in percentage of GDP is 8.46 per cent.

5 Conclusion

Sub-Saharan Africa is one of the regions globally where income inequality is the most pronounced. One of the instruments available to governments to reduce income inequality is taxation. Building on these elements, we investigate the effects of taxation on income inequality in SSA. We use OLS, 2SLS, and IVQR for the estimates. We show that taxation widens income inequality in SSA over the period 1980–2018. Total revenue, total non-resource tax revenue, direct taxes, and indirect taxes increase income inequality in the region. Therefore, total revenue and its direct and indirect components widen income inequality in SSA. In addition, globally, the increasing effects of taxation on income inequality are greater in the most unequal countries of the region compared with the least unequal countries. Moreover, the results highlight an inverse U-shaped relationship between indirect taxes and income inequality. When these taxes are less than 28.36 per cent of GDP, they exacerbate inequality. However, once they exceed this threshold, they become equalizing. From these results, it emerges that priority should be given to increasing indirect taxes to at least 28 per cent of GDP in order to reap the dividends in terms of reducing income inequality.

References

Adam, A., P. Kammas, and A. Lapatinas (2015). 'Income Inequality and the Tax Structure: Evidence from Developed and Developing Countries'. *Journal of Comparative Economics*, 43(1): 138–54. https://doi.org/10.1016/j.jce.2014.05.006

Alavuotunki, K., M. Haapanen, and J. Pirttilä (2019). 'The Effects of the Value-Added Tax on Revenue and Inequality'. *The Journal of Development Studies*, 55(4): 490–508. https://doi.org/10.1080/00220388.2017.1400015

Al-Marhubi, F. (1997). 'A Note on the Link between Income Inequality and Inflation'. *Economics Letters*, 55(3): 317–19. http://dx.doi.org/10.1016/s0165-1765(97)00108-0

Altunbaş, Y., and J. Thornton (2018). 'The Impact of Financial Development on Income Inequality: A Quantile Regression Approach'. *Economics Letters*, 175: 51–56. https://doi.org/10.1016/j.econlet.2018.12.030

Alvaredo, F., L. Chancel, T. Piketty, E. Saez, and G. Zucman (2018). *World Inequality Report 2018*. Paris: World Inequality Lab. Available at: https://wir2018.wid.world/files/download/wir2018-full-report-english.pdf (accessed 1 September 2022). https://doi.org/10.4159/9780674984769

Atkinson, T. (2015). 'What Can Be Done About Inequality?' *Juncture*, 22(1): 32–41. https://doi.org/10.1111/j.2050-5876.2015.00834.x

Atkinson, A.B., and A. Leigh (2010). 'The Distribution of Top Incomes in Five Anglo-Saxon Countries Over the Twentieth Century'. Discussion Paper 4937. Bonn: IZA (Institute of Labour Economics). http://dx.doi.org/10.2139/ssrn.1631072

Bachas, P., L. Gadenne, and A. Jensen (2020). 'Informality, Consumption Taxes and Redistribution'. Working paper 27429. Cambridge, MA: National Bureau of Economic Research. Available at: https://www.nber.org/system/files/working_papers/w27429/w27429.pdf (accessed 1 September 2022).

Bahamonde, H., and M. Trasberg (2021). 'Inclusive Institutions, Unequal Outcomes: Democracy, State Capacity, and Income Inequality'. *European Journal of Political Economy*, 70: 102048. https://doi.org/10.1016/j.ejpoleco.2021.102048

Bang, J.T., A. Mitra, and P.V. Wunnava (2016). 'Do Remittances Improve Income Inequality? An Instrumental Variable Quantile Analysis of the Kenyan Case'. *Economic Modelling*, 58: 394–402. http://dx.doi.org/10.1016/j.econmod.2016.04.004

Bargain, O., and P Kwenda (2014). 'The Informal Sector Wage Gap: New Evidence using Quantile Estimations on Panel Data'. *Economic Development and Cultural Change*, 63(1): 117–53. https://doi.org/10.1086/677908

Benhabib, J., A. Bisin, and S. Zhu (2011). 'The Distribution of Wealth and Fiscal Policy in Economies with Finitely Lived Agents'. *Econometrica*, 79(1): 123–57. https://doi.org/10.3982/ECTA8416

Berg, A.G., and J.D. Ostry (2017). 'Inequality and Unsustainable Growth: Two Sides of the Same Coin?' *IMF Economic Review*, 65(4): 792–815. https://doi.org/10.1057/s41308-017-0030-8

Bergh, A., and T. Nilsson (2010). 'Do Liberalization and Globalization Increase Income Inequality?' *European Journal of Political Economy*, 26(4): 488–505. https://doi.org/10.1016/j.ejpoleco.2010.03.002

Billger, S., and R. Goel (2009). 'Do Existing Corruption Levels Matter in Controlling Corruption? Cross-Country Quantile Regression Estimates'. *Journal of Development Economics,90*(2): 299–305. https://doi.org/10.1016/j.jdeveco.2008.07.006

Bird, R.M. (2003). 'Taxation in Latin America: Reflections on Sustainability and the Balance between Equity and Efficiency'. https://doi.org/10.2139/ssrn.1393962

Björklund, A. (1991). 'Unemployment and Income Distribution: Time-Series Evidence from Sweden'. *The Scandinavian Journal of Economics*, 93(3): 457–65. https://doi.org/10.2307/3440187

Blanchard, O., and D. Rodrik (2021). *Combating Inequality: Rethinking Government's Role*. Cambridge: MIT Press. https://doi.org/10.7551/mitpress/13469.001.0001

Brinca, P., M.H. Ferreira, F. Franco, H.A. Holter, and L. Malafry (2021). 'Fiscal Consolidation Programs and Income Inequality'. *International Economic Review*, 62(1): 405–60. https://doi.org/10.1111/iere.12482

Cabrera, M., N. Lustig, and H.E. Moran (2015). 'Fiscal Policy, Inequality, and the Ethnic Divide in Guatemala'. World Development, 76: 263–79. https://doi.org/10.1016/j.worlddev.2015.07.008

CSP (Center for Systemic Peace) (2022). 'Polity5: Regime Authority Characteristics and Transitions Datasets'. Available at: www.systemicpeace.org/inscrdata.html (accessed 1 September 2022).

Cevik, S., and C. Correa-Caro (2019). 'Growing (Un)Equal: Fiscal Policy and Income Inequality in China and BRIC+'. *Journal of the Asia Pacific Economy*, 25(4): 634–53. https://doi.org/10.1080/13547860.2019.1699985

Chancel, L., T. Piketty (2021). 'Global Income Inequality, 1820–2020: The Persistence and Mutation of Extreme Inequality'. *Journal of the European Economic Association*, 19(6): 3025–62. https://doi.org/10.1093/jeea/jvab047

Chernozhukov, V., and C. Hansen (2005). 'An IV Model of Quantile Treatment Effects'. *Econometrica*, 73(1): 245–61. https://doi.org/10.1111/j.1468-0262.2005.00570.x

Chletsos, M., and S. Roupakias (2020). 'Education and Wage Inequality before and during the Fiscal Crisis: A Quantile Regression Analysis for Greece 2006–2016'. *Review of Development Economics*, 24(4): 1333–64. https://doi.org/10.1111/rode.12695

Christopoulos, D., and P. McAdam (2017). 'Do Financial Reforms Help Stabilize Inequality?' *Journal of International Money and Finance*, 70: 45–61. https://doi.org/10.1016/j.jimonfin.2016.05.003

Ciminelli, G., E. Ernst, R. Merola, and M. Giuliodori (2018). 'The Composition Effects of Tax-Based Consolidation on Income Inequality'. *European Journal of Political Economy*, 57: 107–24. https://doi.org/10.1016/j.ejpoleco.2018.08.009

Claus, I., J. Martínez-Vázquez, and V. Vulovic (2013). 'Coping with Rising Inequality in Asia: How Effective Are Fiscal Policies?' *Asian Economic Papers*, 12(3): 1–33. https://doi.org/10.1162/asep_a_00232

Clements, B.J., R.A. Mooij, M. Francese, S. Gupta, and M. Keen (2015). 'Fiscal Policy and Income Inequality: An Overview'. In B.J. Clements, R.A. Mooij, S. Gupta, and M. Keen (eds), *Inequality and Fiscal Policy*. Washington, DC: IMF.

Coady, D., and A. Dizioli (2017). 'Income Inequality and Education Revisited: Persistence, Endogeneity and Heterogeneity'. *Applied Economics*, 50(25): 2747–61. https://doi.org/10.1080/00036846.2017.1406659

Compton, R.A., D.C. Giedeman, and G.A. Hoover (2014). 'A Distributional Analysis of the Benefits of Economic Freedom'. *European Journal of Political Economy*, 33: 121–33. http://dx.doi.org/10.1016/j.ejpoleco.2013.12.001

Cornia, G.A., J.C. Gómez-Sabaini, and B. Martorano (2011). 'A New Fiscal Pact, Tax Policy Changes and Income Inequality: Latin America during the Last Decade'. WIDER Working Paper 2011/70. Helsinki: UNU-WIDER.

Cornia, G.A., A. Odusola, H. Bhorat, and P. Conceição (2017). 'Introduction, Motivation and Overview'. In A. Odusola, G.A. Cornia, H. Bhorat, and P. Conceição (eds), *Income Inequality Trends in Sub-Saharan Africa: Divergence, Determinants and Consequences*. New York: United Nations Development Programme (UNDP).

Demir, A., V. Pesqué-Cela, Y. Altunbaş, and V. Murinde (2020). 'Fintech, Financial Inclusion and Income Inequality: A Quantile Regression Approach'. *The European Journal of Finance*, 28(1): 1–22. https://doi.org/10.1080/1351847X.2020.1772335

Domeij, D., and J. Heathcote (2004). 'On the Distributional Effects of Reducing Capital Taxes'. *International Economic Review*, 45(2): 523–54. https://doi.org/10.1111/j.1468-2354.2004.00135.x

Doyle, M.W., and J.E. Stiglitz (2014). 'Eliminating Extreme Inequality: A Sustainable Development Goal, 2015–2030'. *Ethics & International Affairs*, 28(1): 5–13. https://doi.org/10.1017/s0892679414000021

Duncan, D., and K. Sabirianova Peter (2016). 'Unequal Inequalities: Do Progressive Taxes Reduce Income Inequality?' *International Tax and Public Finance*, 23(8): 762–83. https://doi.org/10.1007/s10797-016-9412-5

Fosu, A.K. (2018). 'Economic Structure, Growth, and Evolution of Inequality and Poverty in Africa: An Overview'. *Journal of African Economies*, 27(1): 1–9. https://doi.org/10.1093/jae/ejx036

Freitas, J.D. (2012). 'Inequality, the Politics of Redistribution and the Tax Mix'. *Public Choice*, 151(3–4): 611–30. https://doi.org/10.1007/s11127-010-9761-z

Goñi, E., H.J. López, and L. Servén (2011). 'Fiscal Redistribution and Income Inequality in Latin America'. *World Development*, 39(9): 1558–69. https://doi.org/10.1016/j.worlddev.2011.04.025

Hao, L., and D.Q. Naiman (2007). *Quantile Regression: Series-Quantitative Applications in the Social Sciences*. Online: SAGE Publications. https://dx.doi.org/10.4135/9781412985550

Hayes, T.J., and X.D. Medina Vidal (2015). 'Fiscal Policy and Economic Inequality in the U.S. States: Taxing and Spending from 1976 to 2006'. *Political Research Quarterly*, 2(68): 392–407. https://doi.org/10.1177/1065912915578461

Heimberger, P. (2020). 'Does Economic Globalisation Affect Income Inequality? A Meta-Analysis'. *The World Economy*, 43: 2960–82. https://doi.org/10.1111/twec.13007

Holcombe, R.G., and C.J. Boudreaux (2016). 'Market Institutions and Income Inequality'. *Journal of Institutional Economics*, 12(2): 263–76. http://dx.doi.org/10.1017/S1744137415000272

Huang, K., W. Yan, N. Sim, Y. Guo, and F. Xie (2022). 'Can Trade Explain the Rising Trends in Income Inequality? Insights from 40 Years of Empirical Studies'. *Economic Modelling*, 107: 105725. https://doi.org/10.1016/j.econmod.2021.105725

Hubmer, J., P. Krusell, and A.A. Smith (2016). 'The Historical Evolution of the Wealth Distribution'. Working paper 23011. Cambridge, MA: NBER (National Bureau of Economic Research). Available at: www.nber.org/system/files/working_papers/w23011/w23011.pdf (accessed 1 September 2022).

IMF (International Monetary Fund) (2009). *Balance of Payments and International Investment Position Manual*. Sixth edition (BPM6). Washington, DC: IMF. https://doi.org/10.5089/9781462370719.004

IMF (2015). *Inequality and Economic Outcomes in Sub-Saharan Africa*. Washington, DC: IMF.

Jellema, J., and C. Tassot (2018). 'Analyse de l'impact des politiques fiscales et de protection sociale sur les inégalités et la pauvreté au Togo'. *Document d'orientation de l'OCDE sur le développement* 12. Paris: OECD.

Kaplan, D.M., and Y. Sun. (2017). 'Smoothed Estimating Equations for Instrumental Variables Quantile Regression'. *Econometric Theory*, 33(1): 105–57. https://doi.org/10.1017/S0266466615000407

Karakotsios, A., C. Katrakilidis, D. Dimitriadis, and T. Christoforidis (2016). 'Examining the Relationship between Income Inequality, Taxation and Economic Freedom: A Panel Cointegration Approach'. *Economics and Business Letters*, 9(3): 206–15. http://dx.doi.org/10.17811/ebl.9.3.2020.206-215

Kim, D.-H., T.-C. Chen, and S.-C. Lin, (2020). 'Does Oil Drive Income Inequality? New Panel Evidence'. *Structural Change and Economic Dynamics*, 55: 137–52. http://dx.doi.org/10.1016/j.strueco.2020.08.002

Koudalo, Y.M.A., J. Wub (2022). 'Does Financial Liberalization Reduce Income Inequality? Evidence from Africa'. *Emerging Markets Review*, online 11 July: 100945. https://doi.org/10.1016/j.ememar.2022.100945

Kudryavtsev, A.A. (2009). 'Using Quantile Regression for Rate-Making'. *Insurance: Mathematics and Economics*, 45(2): 296–304. https://doi.org/10.1016/j.insmatheco.2009.07.010

Kuznets, S. (1955). 'Economic Growth and Income Inequality'. *American Economic Review*, 45(1): 1–28.

La Porta, R. (1999). 'The Quality of Government'. *Journal of Law, Economics, and Organization*, 15(1): 222–79. https://doi.org/10.1093/jleo/15.1.222

La-Porta, R., F. Lopez-de-Silanes, and A. Shleifer. (2008). 'The Economic Consequences of Legal Origins'. *Journal of Economic Literature*, 46(2): 285–332. https://doi.org/10.1257/jel.46.2.285

Li, J., and H. Yu (2014). 'Income Inequality and Financial Reform in Asia: The Role of Human Capital'. *Applied Economics*, 46(24): 2920–35. http://dx.doi.org/10.1080/00036846.2014.916390

Martínez-Vázquez, J., B. Moreno-Dodson, and V. Vulovic (2012). 'The Impact of Tax and Expenditure Policies on Income Distribution: Evidence from a Large Panel of Countries'. ECON Publications. Atlanta, GA: Department of Economics, Georgia State University. Available at: https://aysps.gsu.edu/working-papers.html-18/04/2022 (accessed 1 September 2022).

Martínez-Vázquez, J., V. Vulovic, and Y. Liu (2011). 'Direct versus Indirect Taxation: Trends, Theory, and Economic Significance'. In E. Albi, and J. Martínez-Vázquez (eds), *The Elgar Guide to Tax Systems*. Northampton, MA: Edward Elgar Publishing.

Martinsa, P.S., and P.T. Pereira (2004). 'Does Education Reduce Wage Inequality? Quantile Regression Evidence from 16 Countries'. *Labour Economics*, 11(3): 355–71. https://doi.org/10.1016/j.labeco.2003.05.003

Martorano, B. (2018). 'Taxation and Inequality in Developing Countries: Lessons from the Recent Experience of Latin America'. *Journal of International Development*, 30(2): 256–73. https://doi.org/10.1002/jid.3350

Mayer, S.E. (2010). 'The Relationship between Income Inequality and Inequality in Schooling'. *Theory and Research in Education*, 8(1): online 22 April. https://doi.org/10.1177/1477878509356346

Meltzer, A., and S.F. Richard (1981). 'A Rational Theory of Government Size'. *Journal of Political Economy*, 89(5): 914–27. https://doi.org/10.1086/261013

Mirrlees, J.A. (1971). 'An Exploration in the Theory of Optimum Income Taxation'. *The Review of Economic Studies*, 38(2): 175–208. https://doi.org/10.2307/2296779

Muinelo-Gallo, L., and O. Roca-Sagalés (2011). 'Economic Growth and Inequality: The Role of Fiscal Policies'. *Australian Economic Papers*, 50(2–3): 74–97. https://doi.org/10.1111/j.1467-8454.2011.00412.x

Muinelo-Gallo, L., and O. Roca-Sagalés (2013). 'Joint Determinants of Fiscal Policy, Income Inequality and Economic Growth'. *Economic Modelling*, 30: 814–24. https://doi.org/10.1016/j.econmod.2012.11.009

Musgrave, R.A. (1959). *The Theory of Public Finance: A Study in Public*. New York: McGraw Hill.

Nantob, N. (2016). 'Taxation and Income Inequality in Developing Countries: An Empirical Investigation'. *Economics Bulletin*, 36(3): 1508–22. Available at: http://www.accessecon.com/Pubs/EB/2015/Volume35/EB-15-V35-I4-P288.pdf (accessed day month year) ((accessed 1 September 2022).

Odusola, A. (2017). 'Fiscal Space, Poverty and Inequality in Africa'. *African Development Review*, 29(S1): 1–14. https://doi.org/10.1111/1467-8268.12229

Ostry, J.D., A. Berg, C.G. Tsangarides, and O.J. Blanchard (2014). *Redistribution, Inequality, and Growth*. Washington, DC: IMF. https://doi.org/10.5089/9781484352076.006

Pan-Long, T. (1995). 'Foreign Direct Investment and Income Inequality: Further Evidence'. *World Development*, 23(3): 469–83. http://dx.doi.org/10.1016/0305-750x(95)00136-z

Piketty, T. (2001). *Les hauts revenus en France au XXè siècele: Inégalités et redistributions, 1901–1998*. Paris: Bernard Grasset.

Piketty, T. (2014). *Capital in the 21st Century*. London: The Belknap Press of Harvard University Press. https://doi.org/10.4159/9780674369542

Ragot, X. (2017). 'Hétérogénéité et économie: Inégalité et imperfections financières'. *Revue d'Economie Financière*, 128: 109–24. https://doi.org/10.3917/ecofi.128.0109

Ramos, X., and O. Roca-Sagalés (2008). 'Long-Term Effects of Fiscal Policy on the Size and Distribution of the Pie in the UK'. *The Journal of Applied Public Economics/Fiscal studies*, 29(3): 387–411. https://doi.org/10.1111/j.1475-5890.2008.00079.x

Ramsey, F.P. (1927). 'A Contribution to the Theory of Taxation'. *The Economic Journal*, 37(145): 47–61. https://doi.org/10.2307/2222721

Risso, W.A., L.F. Punzo, and E.J. Sánchez Carrera (2013). 'Economic Growth and Income distribution in Mexico: A Cointegration Exercise'. *Economic Modelling*, 35: 708–14. https://doi.org/10.1016/j.econmod.2013.08.036

Rodrik, D. (2000). 'Institutions for High-Quality Growth: What They Are and How to Acquire Them'. *Studies in Comparative International Development*, 35(3): 3–31. https://doi.org/10.1007/BF02699764

Salotti, S., and C. Trecroci (2018). 'Cross-Country Evidence on the Distributional Impact of Fiscal Policy'. *Applied Economics*, 50(51): 5521–42. https://doi.org/10.1080/00036846.2018.1487001

Song, Y. (2013). 'Rising Chinese Regional Income Inequality: The Role of Fiscal Decentralization'. *China Economic Review*, 27: 294–309. https://doi.org/10.1016/j.chieco.2013.02.001

Stiglitz, J.E. (2012). *Le prix de l'inégalité*. New York: W.W. Norton & Company.

Stolper, W.F., and P.A. Samuelson (1941). 'Protection and Real Wages'. *Review of Economic Studies*, 9(1): 58–73. https://doi.org/10.2307/2967638

Sulemana, I., E. Nketiah-Amponsah, E.A. Codjoe, and J.A.N. Andoh (2019). 'Urbanization and Income Inequality in Sub-Saharan Africa'. *Sustainable Cities and Society*, 48: 101544. http://dx.doi.org/10.1016/j.scs.2019.101544

UNDESA (United Nations Department of Economic and Social Affairs) (2019). 'Income Inequality Trends: The Choice of Indicators Matters'. New York: UNDESA Social Development Brief.

UNU-WIDER (2021a). 'Government Revenue Dataset'. Version 2021. Helsinki: UNU-WIDER. https://doi.org/10.35188/UNU-WIDER/GRD-2021

UNU-WIDER (2021b). 'World Income Inequality Database (WIID)'. Version 31 May 2021. Helsinki: UNU-WIDER. https://doi.org/10.35188/UNU-WIDER/WIID-310521

World Bank (2022). *World Development Indicators*. Washington, DC: World Bank.

Xu, C., M. Han, T.A. Dossou, and F.V. Bekun (2021). 'Trade Openness, FDI, and Income Inequality: Evidence from Sub-Saharan Africa'. *African Development Review*, 33(1): 193–203. https://doi.org/10.1111/1467-8268.12511

Yang, T.-C., V.Y.-J. Chen, C. Shoff, and S.A. Matthews (2012). 'Using Quantile Regression to Examine the Effects of Inequality across the Mortality Distribution in the U.S. Counties'. *Social Science & Medicine*, 74(12): 1900–10. https://doi.org/10.1016/j.socscimed.2012.02.029

Appendix

Table A1: Variables, definitions, sources, and description

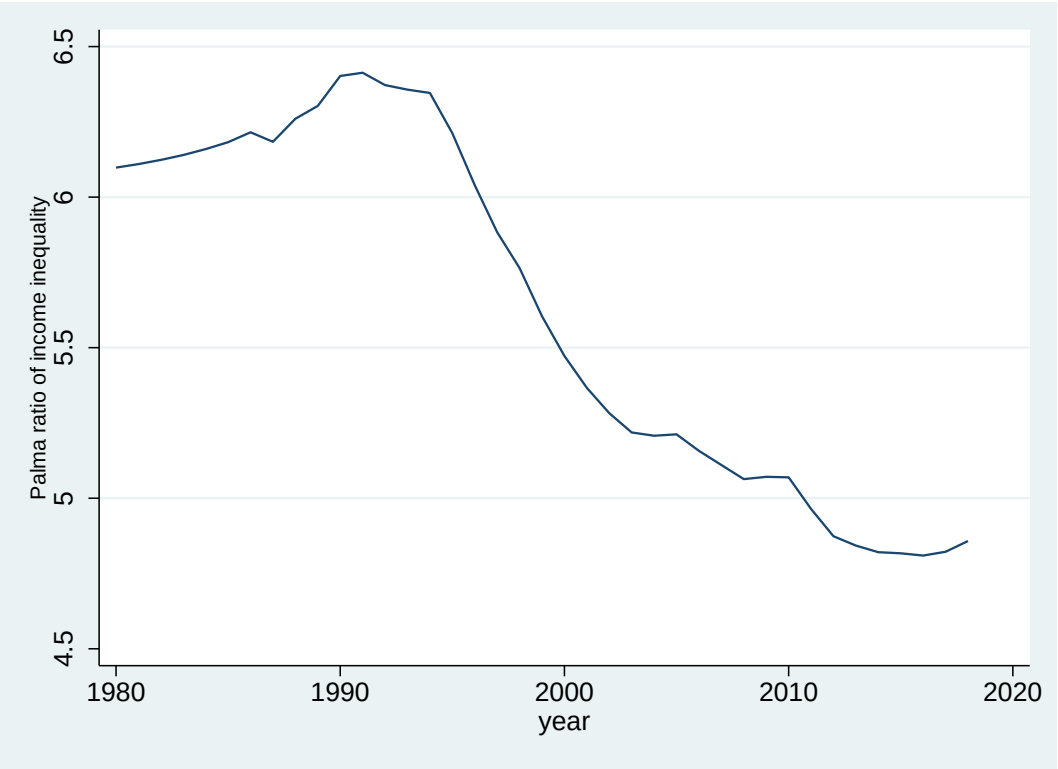
Variables	Variable names	Definitions	Sources	Mean	SD
Gini coefficients	Gini	The measure of income inequality comprising a number between 0 and 100, with 0 the most equal distribution and 100 the most unequal	UNU-WIDER (2021b)	56.994	6.380
Total revenue (% GDP)	TR	Total revenue is revenue excluding grants and social contributions; it is taxes plus non-tax revenue	UNU-WIDER (2021a)	16.678	10.135
Total non-resource tax revenue (% GDP)	TNRR	Non-resource tax excluding social contributions; taxes minus resource taxes	UNU-WIDER (2021a)	12.725	7.058
Direct taxes (% GDP)	DT	Direct taxes excluding social contributions and resource revenue; total direct tax minus resource taxes	UNU-WIDER (2021a)	3.946	3.240
Indirect taxes (% GDP)	NTCIT	Including tax on goods and services and on international trade and other taxes, net of any resource component	GRD, UNU-WIDER (2021a)	8.155	5.484
Primary net school enrolment (%)	EDUC	The ratio of children of official school age enrolled in school to the population of the corresponding official school age; primary education provides children with basic reading, writing, and mathematics skills along with an elementary understanding of such subjects as history, geography, natural sciences, social sciences, art, and music	World Bank (2022)	67.714	20.950
Net inflows of foreign direct investment (% GDP)	FDI	Foreign direct investment is the net inflows of investment to acquire a lasting management interest (10% or more of voting stock) in an enterprise operating in an economy other than that of the investor; it is the sum of equity capital, reinvestment of earnings, other long-term capital, and short-term capital as shown in the balance of payments; this series shows net inflows (new investment inflows minus disinvestment) in the reporting economy from foreign investors, and is divided by GDP	World Bank (2022)	3.005	7.979
Trade openness (% GDP)	OPEN	Sum of exports and imports of goods and services measured as a share of GDP	World Bank (2022)	65.028	34.671
Total natural resources rents (% GDP)	NRR	Sum of oil, natural gas, coal, mineral, and forest rents	World Bank (2022)	11.229	10.834
Urban population (% of total population)	URB	Urban population refers to people living in urban areas	World Bank (2022)	34.683	16.539
Inflation rate (%)	INF	Inflation as measured by the consumer price index reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals, such as yearly; it is a measure of macroeconomic stability	World Bank (2022)	42.141	657.952
Polity2	DEMOC	A measure of political regime authority on a 21-pont scale ranging from −10 (hereditary monarchy) to +10 (consolidated democracy); the highest score reflects the best situation	CSP, Polity IV	−0.456	5.984

Domestic credit to private sector (% GDP)	FD	Financial resources provided to the private sector by financial corporations, such as through loans, purchases of non-equity securities, and trade credits and other accounts receivable, that establish a claim for repayment; a measure of financial development	World Bank (2022)	17.659	19.290
Total employment to population ratio, 15+ (%)	ER	Proportion of a country's population that is employed; employment is defined as persons of working age who, during a short reference period, were engaged in any activity to produce goods or provide services for pay or profit, whether at work during the reference period or not at work due to temporary absence from a job, or to working-time arrangements; those 15 and older are generally considered the working-age population	WDI, World Bank (2022)	61.932	14.861
Government expenditure in education (per cent GDP)	GEE	General government expenditure on education expressed as a percentage of GDP. It includes expenditure funded by transfers from international sources to government. General government usually refers to local, regional, and central governments.	World Bank (2022)	4.106	2.765
Personal received remittances (current US$)	REM	Comprises personal transfers and compensation of employees; personal transfers consist of all current transfers in cash or in kind made or received by resident households to or from non-resident households; they thus include all current transfers between resident and non-resident individuals; compensation of employees refers to the income of border, seasonal, and other short-term workers who are employed in an economy where they are not resident and to residents employed by non-resident entities; data are the sum of two items defined in the sixth edition of the IMF's (2009) Balance of Payments Manual: personal transfers and compensation of employees and are in current US dollars	World Bank (2022)	4.854	19.324
GDP per capita (constant 2010 US$)	RGDP	GDP per capita is GDP divided by mid-year population; GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products; it is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources; data are in constant 2010 US dollars	World Bank (2022)	1638.868	2047.847

Note: SD = standard deviation.

Source: authors' construction based on CSP (2022), UNU-WIDER (2021a,b), and World Bank (2022).

Figure A1: Income inequality trends in SSA,1980–2018



Source: authors' construction based on UNU-WIDER (2021b).

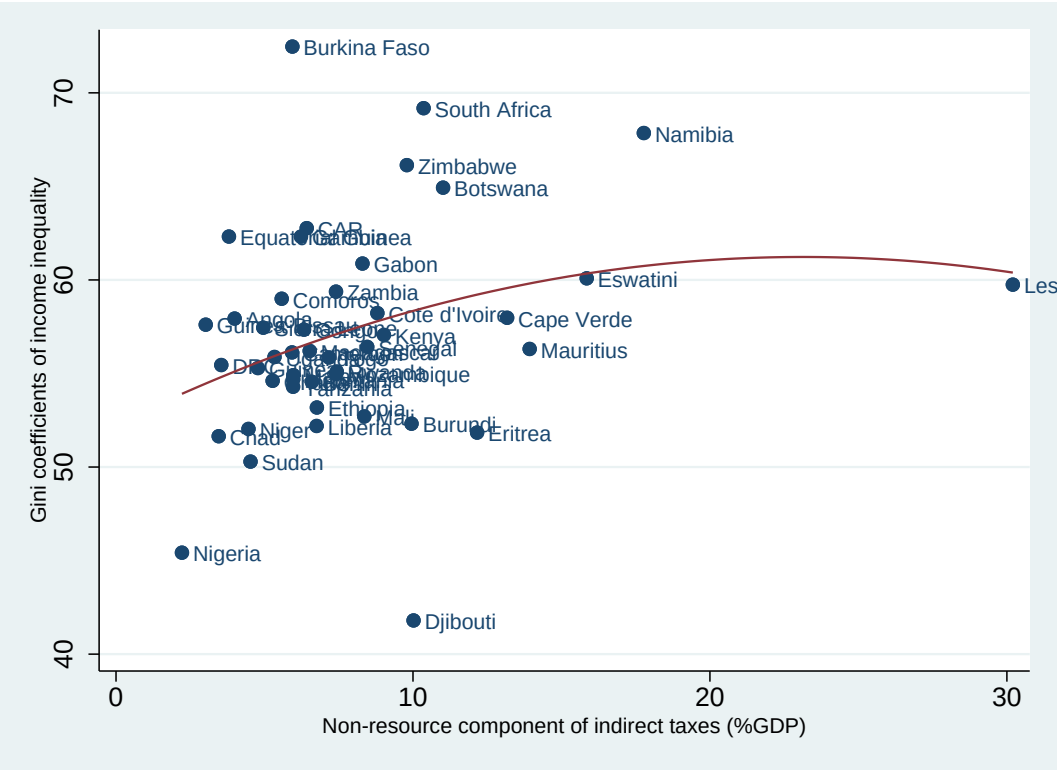
Table A2: Correlation between variables

	TR	TNRR	DT	NTCIT	INEQ	DEMOC	OPEN	FDI	NRR	URB	INF	FD	GEE	EDUC	ER	RGDP	REM
TR	1																
TNRR	0.515***	1															
DT	0.609***	0.861***	1														
NTCIT	0.681***	0.939***	0.566***	1													
INEQ	0.289***	0.472***	0.296***	0.203***	1												
DEMOC	0.120***	0.263***	0.264***	0.220***	0.062**	1											
OPEN	0.550***	0.453***	0.248***	0.437***	0.126***	0.107***	1										
FDI	0.086***	−0.021	−0.009	−0.021	−0.037	0.064***	0.311***	1									
NRR	0.096***	−0.461***	−0.265***	−0.315***	−0.003	−0.149***	0.184***	0.238***	1								
URB	0.330***	−0.016	0.167***	−0.024	−0.001	0.198***	0.392***	0.150***	0.230***	1							
INF	−0.043	−0.117***	−0.066**	−0.072**	−0.007	−0.014	−0.022	−0.012	0.061**	−0.004	1						
FD	0.353***	0.562***	0.667***	0.282***	0.201***	0.281***	0.171***	−0.034	−0.195***	0.311***	−0.035	1					
GEE	0.490***	0.730***	0.488***	0.487***	0.272***	0.103***	0.231***	−0.026	−0.140***	−0.012	−0.060*	0.198***	1				
EDUC	0.331***	0.6141***	0.355***	0.314***	0.156***	0.438***	0.318***	0.092***	−0.030	0.196***	−0.024	0.279***	0.225***	1			
ER	−0.381***	−0.3798***	−0.228***	−0.294***	−0.058**	−0.069**	−0.397***	−0.023	0.109***	−0.548***	0.037	−0.297***	−0.162***	−0.095**	1		
RGDP	0.485***	0.146***	0.249***	0.125***	0.274***	0.112***	0.387***	0.033	0.163***	0.620***	−0.023	0.420***	0.175***	0.326***	−0.504***	1	
REM	0.290***	0.174***	0.028	0.550***	0.048*	−0.034	0.222***	0.016	−0.052*	−0.152***	−0.006	−0.019	0.218***	−0.003	−0.153***	−0.096***	1

Note: *, **, and *** represent significance at 10%, 5%, and 1%.

Source: authors' construction based on CSP (2022), UNU-WIDER (2021a,b), and World Bank (2022).

Figure A2: Hump-shaped relationship between indirect taxes and income inequality, 1980–2018



Source: authors' construction based on UNU-WIDER (2021a, b).

Table A3: Total revenue and income inequality in SSA, 1980–2018

	Dependent variable: Palma ratio of income inequality						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Independent variables	OLS	IV-2SLS	IVQR 0.10	IVQR 0.25	IVQR 0.50	IVQR 0.75	IVQR 0.90
Total revenue	0.101***	0.102***	0.0623***	0.0613***	0.0754***	0.109***	0.162***
	(0.0124)	(0.0161)	(0.0103)	(0.0129)	(0.0183)	(0.0195)	(0.0254)
Democracy (polity2)	−0.116***	−0.159***	−0.0496***	−0.0609***	−0.0665***	−0.0850***	−0.0661
	(0.0333)	(0.0420)	(0.0185)	(0.0126)	(0.0159)	(0.0350)	(0.0419)
Trade openness	−0.0257***	−0.0232***	−0.0188***	−0.0164***	−0.0191***	−0.0247***	−0.0258***
	(0.00289)	(0.00341)	(0.00337)	(0.00257)	(0.00262)	(0.00330)	(0.00388)
Foreign direct investment	−0.0204	−0.0270	0.0301**	0.0173**	0.00215	−0.0129	−0.0587*
	(0.0161)	(0.0202)	(0.0142)	(0.00706)	(0.00988)	(0.0167)	(0.0339)
Total natural resources rents	−0.00539	0.00143	−0.00863	−0.00794	−0.00803	−0.00282	0.0130
	(0.0105)	(0.0152)	(0.00707)	(0.00567)	(0.0117)	(0.0192)	(0.0280)
Urbanization rate	0.0256***	0.0272***	0.0141**	0.0134*	0.0242**	0.0224	−0.0153
	(0.00810)	(0.00937)	(0.00709)	(0.00721)	(0.0109)	(0.0156)	(0.0152)
Inflation rate	0.0631**	0.0649*	0.0281***	0.0263***	0.0253***	0.0227**	0.0228
	(0.0304)	(0.0360)	(0.00929)	(0.00477)	(0.00950)	(0.0112)	(0.0419)
Financial development	0.0330***	0.0399***	−0.00444	0.00494	0.00401	0.0185	0.0529***
	(0.00793)	(0.0119)	(0.00748)	(0.00747)	(0.0146)	(0.0123)	(0.0176)
Public expenditure on education	0.266***	0.325***	0.186***	0.182***	0.236***	0.239***	0.268**
	(0.0616)	(0.0719)	(0.0479)	(0.0361)	(0.0695)	(0.0753)	(0.120)
Primary education	−0.0266*	−0.0393**	0.00883	0.00146	−0.00364	−0.0173**	−0.0640**
	(0.0144)	(0.0176)	(0.00841)	(0.00545)	(0.00578)	(0.00686)	(0.0317)
Employment rate	−0.0130	0.000906	−0.0123**	−0.00799	−0.00993*	−0.0256	−0.0337
	(0.0168)	(0.0214)	(0.00579)	(0.00522)	(0.00602)	(0.0160)	(0.0314)
Ln(GDP per capita)	−5.271	−4.410	0.0173	0.484	−3.681	−3.290	3.577
	(4.136)	(3.923)	(1.939)	(1.458)	(3.057)	(2.760)	(9.106)
Ln(GDP per capita squared)	0.336	0.286	0.0285	−0.0152	0.258	0.214	−0.296
	(0.290)	(0.276)	(0.120)	(0.0992)	(0.228)	(0.181)	(0.644)
Ln(Remittances)	−0.0697	−0.0459	−0.104***	−0.0675**	−0.0656	−0.132	−0.276*
	(0.137)	(0.150)	(0.0313)	(0.0307)	(0.0587)	(0.0956)	(0.167)
Constant	25.63*	21.63	1.420	0.761	16.79	18.75**	1.350
	(14.38)	(13.42)	(5.569)	(5.099)	(10.52)	(8.232)	(32.77)
Observations	322	272	272	272	272	272	272

R-squared	0.429	0.375
Prob > F	0.0000	
Kleibergen-Paap rk LM statistic p-value		0.0000
Cragg-Donald Wald F statistic		274.383
Hansen test P-value		0.5888

Note: robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' construction based on CSP (2022), UNU-WIDER (2021a,b), and World Bank (2022).

Table A4: Total non-resource revenue and income inequality in SSA, 1980–2018

	Dependent variable: Palma ratio of income inequality						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Independent variables	OLS	IV-2SLS	IVQR 0.10	IVQR 0.25	IVQR 0.50	IVQR 0.75	IVQR 0.90
Total non-resource revenue	0.106***	0.106***	0.0462	0.0861**	0.118***	0.111**	0.147***
	(0.0238)	(0.0352)	(0.0472)	(0.0395)	(0.0294)	(0.0446)	(0.0496)
Democracy (polity2)	0.00550	0.00464	−0.0256	−0.0156	−0.00935	−0.0250	0.00796
	(0.0159)	(0.0194)	(0.0294)	(0.0181)	(0.0189)	(0.0339)	(0.0158)
Trade openness	−0.0163***	−0.0133***	−0.0134***	−0.0134***	−0.0168***	−0.0172***	−0.0150***
	(0.00287)	(0.00362)	(0.00339)	(0.00404)	(0.00396)	(0.00416)	(0.00330)
Foreign direct investment	−0.00729	−0.0107	−0.00721	−0.00544	−0.0183	−0.0301	−0.0618
	(0.0131)	(0.0169)	(0.0103)	(0.0122)	(0.0143)	(0.0220)	(0.0387)
Total natural resources rents	0.0202***	0.0231***	0.00592	0.0151	0.0208**	0.0181*	0.0211***
	(0.00529)	(0.00743)	(0.0134)	(0.0103)	(0.00971)	(0.0105)	(0.00670)
Urbanization rate	−0.000678	−0.00538	0.0141	0.0181	0.00990	−0.0162	−0.0290
	(0.00961)	(0.0122)	(0.0159)	(0.0125)	(0.0190)	(0.0135)	(0.0177)
Inflation rate	0.0166**	0.0147*	0.0333***	0.0285***	0.0186**	0.00787	0.00841
	(0.00697)	(0.00815)	(0.0127)	(0.0100)	(0.00870)	(0.0126)	(0.00892)
Financial development	−0.0533***	−0.0577***	−0.0704***	−0.0678***	−0.0536***	−0.0448***	−0.0468***
	(0.00834)	(0.0105)	(0.0122)	(0.0160)	(0.0120)	(0.0103)	(0.0106)
Public expenditure on education	0.277***	0.267***	0.210***	0.197***	0.217***	0.378***	0.408***
	(0.0592)	(0.0721)	(0.0417)	(0.0519)	(0.0621)	(0.117)	(0.0945)
Primary education	0.00262	0.00288	0.0108**	0.00426	−0.00322	−0.00188	0.00290
	(0.00399)	(0.00467)	(0.00536)	(0.00598)	(0.00576)	(0.00480)	(0.00406)
Employment rate	0.0117	0.0237*	0.0354***	0.0348**	0.0158	−0.00539	−0.000447
	(0.0109)	(0.0142)	(0.0132)	(0.0156)	(0.0188)	(0.0188)	(0.0212)
Ln(GDP per capita)	−5.016**	−5.416*	−13.00**	−13.08***	−8.259**	−3.010	0.240
	(2.307)	(2.825)	(5.306)	(4.355)	(3.472)	(3.817)	(4.296)
Ln(GDP per capita squared)	0.433***	0.475**	1.006***	1.006***	0.659***	0.290	0.0558
	(0.162)	(0.196)	(0.376)	(0.310)	(0.255)	(0.281)	(0.317)
Ln(Remittances)	−0.170***	−0.140**	−0.117	−0.0913	−0.0860	−0.103	−0.201**
	(0.0590)	(0.0675)	(0.0835)	(0.0614)	(0.0564)	(0.0798)	(0.0853)
Constant	16.55**	16.55	41.73**	42.38***	27.97**	11.86	0.260
	(8.198)	(10.22)	(20.80)	(14.13)	(12.61)	(13.82)	(15.34)
Observations	133	115	115	115	115	115	115

R-squared	0.796	0.798
Prob > F	0.0000	
Kleibergen-Paap rk LM statistic p-value		0.0001
Cragg-Donald Wald F statistic		51.780
Hansen test P-value		0.7577

Note: robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' construction based on CSP (2022), UNU-WIDER (2021a,b), and World Bank (2022).

Table A5: Direct taxes and income inequality in SSA, 1980–2018

	Dependent variable: Palma ratio of income inequality						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Independent variables	OLS	IV-2SLS	IVQR 0.10	IVQR 0.25	IVQR 0.50	IVQR 0.75	IVQR 0.90
Direct taxes	0.343***	0.352***	0.233***	0.261***	0.310***	0.424***	0.618***
	(0.0614)	(0.0692)	(0.0605)	(0.0701)	(0.0692)	(0.0485)	(0.0950)
Democracy (polity2)	−0.0912***	−0.114***	−0.0424**	−0.0359**	−0.0530*	−0.0723*	−0.0115
	(0.0305)	(0.0382)	(0.0203)	(0.0154)	(0.0286)	(0.0369)	(0.0551)
Trade openness	−0.0228***	−0.0220***	−0.0189***	−0.0169***	−0.0200***	−0.0252***	−0.0260***
	(0.00260)	(0.00310)	(0.00402)	(0.00275)	(0.00314)	(0.00293)	(0.00370)
Foreign direct investment	−0.0347**	−0.0453**	0.00817	−0.000297	−0.0220*	−0.0381**	−0.113***
	(0.0154)	(0.0193)	(0.0182)	(0.00870)	(0.0116)	(0.0162)	(0.0294)
Total natural resources rents	0.0118	0.00151	−0.000569	−0.00517	0.00345	0.0111	0.0313
	(0.0125)	(0.0168)	(0.00856)	(0.00816)	(0.0107)	(0.0135)	(0.0250)
Urbanization rate	0.0223***	0.0206*	0.0166	0.0133*	0.0188**	0.00279	−0.0147
	(0.00858)	(0.0104)	(0.0108)	(0.00754)	(0.00946)	(0.0134)	(0.0187)
Inflation rate	0.0334	0.0353	0.0348*	0.0211	0.0162	0.0101	−0.00508
	(0.0279)	(0.0335)	(0.0187)	(0.0151)	(0.0130)	(0.0131)	(0.0365)
Financial development	−0.00639	0.00213	−0.00202	−0.00277	−0.0151	−0.0259***	−0.0239
	(0.0105)	(0.0133)	(0.0131)	(0.00827)	(0.0129)	(0.00853)	(0.0214)
Public expenditure on education	0.242***	0.292***	0.125*	0.0898	0.173*	0.242***	0.260*
	(0.0805)	(0.0969)	(0.0703)	(0.0769)	(0.103)	(0.0900)	(0.135)
Primary education	−0.0403**	−0.0486**	0.00563	−0.00548	−0.0103*	−0.0304	−0.0805**
	(0.0183)	(0.0207)	(0.00900)	(0.00609)	(0.00545)	(0.0185)	(0.0318)
Employment rate	0.00751	0.0206	−0.0109	−0.00217	−0.00458	−0.00950	0.0116
	(0.0212)	(0.0261)	(0.00854)	(0.00747)	(0.00747)	(0.0219)	(0.0438)
Ln(GDP per capita)	−17.91***	−17.06***	0.249	−1.850	−11.04**	−17.88***	−22.09**
	(6.659)	(6.467)	(7.750)	(3.271)	(5.042)	(4.620)	(8.717)
Ln(GDP per capita squared)	1.276***	1.221***	0.0209	0.166	0.801**	1.299***	1.576**
	(0.475)	(0.463)	(0.538)	(0.227)	(0.362)	(0.311)	(0.628)
Ln(Remittances)	0.134	0.181	−0.1000	−0.0329	0.00453	0.0508	0.0778
	(0.194)	(0.211)	(0.0915)	(0.0706)	(0.0815)	(0.107)	(0.247)
Constant	68.33***	64.74***	0.379	8.778	42.57**	68.97***	88.53***
	(23.14)	(22.20)	(24.73)	(11.67)	(17.42)	(15.07)	(28.35)
Observations	271	233	233	233	233	233	233

R-squared	0.429	0.408
Prob > F	0.0000	
Kleibergen-Paap rk LM statistic p-value		0.0000
Cragg-Donald Wald F statistic		269.305
Hansen test P-value		0.2608

Note: robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' construction based on CSP (2022), UNU-WIDER (2021a,b), and World Bank (2022).

Table A6: Indirect taxes and income inequality in SSA, 1980–2018

	Dependent variable: Palma ratio of income inequality						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Independent variables	OLS	IV-2SLS	IVQR 0.10	IVQR 0.25	IVQR 0.50	IVQR 0.75	IVQR 0.90
Indirect taxes	0.0561**	0.0279	0.0525***	0.0369***	0.0276*	0.00448	0.0257
	(0.0244)	(0.0334)	(0.0202)	(0.00956)	(0.0143)	(0.0383)	(0.0383)
Democracy (polity2)	−0.101**	−0.104*	−0.0316**	−0.0271	−0.0233	−0.0262	−0.102**
	(0.0430)	(0.0575)	(0.0146)	(0.0177)	(0.0268)	(0.0311)	(0.0416)
Trade openness	−0.0282***	−0.0273***	−0.0196***	−0.0176***	−0.0217***	−0.0289***	−0.0269***
	(0.00459)	(0.00578)	(0.00471)	(0.00271)	(0.00402)	(0.00310)	(0.00362)
Foreign direct investment	0.0150	0.0131	0.0341***	0.0292***	0.0323***	0.0387***	0.0120
	(0.0140)	(0.0189)	(0.00911)	(0.00960)	(0.00949)	(0.0139)	(0.0139)
Total natural resources rents	−0.00391	−0.0189	−0.0134	−0.0175**	−0.0218	−0.0390**	−0.0199
	(0.0139)	(0.0187)	(0.0103)	(0.00791)	(0.0138)	(0.0197)	(0.0184)
Urbanization rate	0.0254**	0.0178	0.00415	0.000867	0.00544	−0.00733	0.0168
	(0.0110)	(0.0142)	(0.00767)	(0.00578)	(0.00996)	(0.0143)	(0.0133)
Inflation rate	0.0612*	0.0704*	0.0223*	0.0170**	0.0143	0.0249*	0.0687**
	(0.0340)	(0.0424)	(0.0115)	(0.00865)	(0.0109)	(0.0147)	(0.0347)
Financial development	0.0225**	0.0294**	0.00442	0.00658	−0.000244	0.00661	0.0305**
	(0.00988)	(0.0144)	(0.00964)	(0.00765)	(0.0154)	(0.0108)	(0.0122)
Public expenditure on education	0.394***	0.475***	0.221**	0.220***	0.288***	0.409**	0.470***
	(0.0691)	(0.0747)	(0.0927)	(0.0369)	(0.0812)	(0.164)	(0.0869)
Primary education	−0.0346*	−0.0422*	0.00175	−0.00153	−0.00683	−0.00780	−0.0435***
	(0.0197)	(0.0223)	(0.00426)	(0.00443)	(0.00646)	(0.00937)	(0.0146)
Employment rate	−0.0227	−0.0245	−0.0243	−0.0281***	−0.0367***	−0.0696***	−0.0214
	(0.0300)	(0.0399)	(0.0161)	(0.00717)	(0.0128)	(0.0223)	(0.0285)
Ln(GDP per capita)	−11.01	−10.03	1.717	1.096	−2.936	−7.782	−10.45*
	(6.990)	(6.951)	(2.600)	(1.783)	(4.218)	(5.430)	(5.493)
Ln(GDP per capita squared)	0.778	0.709	−0.0954	−0.0597	0.225	0.582	0.740*
	(0.498)	(0.496)	(0.180)	(0.119)	(0.305)	(0.414)	(0.385)
Ln(Remittances)	0.0998	0.139	−0.0431	−0.00610	0.0322	−0.0337	0.170
	(0.217)	(0.242)	(0.0572)	(0.0585)	(0.0825)	(0.124)	(0.215)
Constant	45.90*	43.25*	-2.429	1.242	16.85	36.62**	54.51***
	(23.67)	(22.81)	(9.194)	(6.059)	(13.88)	(17.85)	(17.86)

Observations	230	196	196	196	196	196	196
R-squared	0.401	0.387					
Prob > F	0.0000						
Kleibergen-Paap rk LM statistic p-value		0.0000					
Cragg-Donald Wald F statistic		96.814					
Hansen test P-value		0.1501					

Note: robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' construction based on CSP (2022), UNU-WIDER (2021a,b), and World Bank (2022).

Table A7: Effects of control variables on income inequality in SSA, 1980–2018

Control variables	Total revenue	Direct taxes	Indirect taxes	Non-resource revenue
Democracy (polity2)	Yes	Yes	Yes	No
Trade openness	Yes	Yes	Yes	Yes
Foreign direct investment	No	No	Yes	No
Total natural resources rents	No	No	No	Yes
Urbanization rate	No	No	No	Yes
Inflation rate	Yes	No	Yes	Yes
Financial development	Yes	No	No	Yes
Public expenditure on education	Yes	Yes	Yes	Yes
Primary education	No	No	No	No
Employment rate	No	No	Yes	Yes
Ln(GDP per capita)	No	Yes	No	No
Ln(GDP per capita squared)	No	Yes	Yes	No
Ln(Remittances)	No	No	No	Yes

Note: 'yes' means generally statistically significant; 'no' means not generally statistically significant.

Source: authors' construction based on CSP (2022), UNU-WIDER (2021a,b), and World Bank (2022).